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Volume 2:
Case Study of the San Francisco Bay Region: 1976-1978

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16. ABSTRACT

This guideline presents information to assist States and local agencies in preparing ozone control strategies for nonattainment areas. The guidance should be most useful in preparing 1982 State Implementation Plan revisions.

The guideline covers the following topics: Intergovernmental Cooperation, Development and Assessment of Air Quality and Emissions Data, Modeling to Related Air Quality to Emissions, Control Strategy Analysis and Assessment, Plan Adoption, and the Continuing Planning Process. This volume covers the case study for the San Francisco Bay Region: 1976-1978.

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by

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GLOSSARY

The definition of terms and acronyms used in this report are given below:

ABAG:	Association of Bay Area Governments
AP-42:	EPA document, Compilation of Air Pollution Emission Factors including supplements
AQMP:	Air Quality Maintenance Plan
BAAPCD:	Bay Area Air Pollution Control District
BAAQMD:	Bay Area Air Quality Management District, formerly the BAAPCD
Bay Area:	San Francisco Bay Area
Caltrans:	California Department of Transportation
CARB/ARB:	California Air Resources Board
CTG:	Control Technologies Guidelines
EMTF:	Environmental Management Task Force
EMFAC3:	Code name for the mobile emission model developed by CARB
FHWA:	Federal Highway Administration
HDD:	Heavy duty diesel-powered vehicle
HDG:	Heavy duty gasoline-powered vehicle
ISR:	Indirect Source Review
LDA:	Light duty automobile
LDT:	Light duty truck
JTS:	Joint Technical Staff
LIRAQ:	Livermore Regional Air Quality Model
LLL:	Livermore Lawrence Laboratory
MTC:	Metropolitan Transportation Commission
NSR:	New Source Review
NO_x:	Oxides of Nitrogen

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PRB:	Program Review Board
O_3:	Ozone
QSOR:	Code name for the final disaggregated source inventory file which serves as input to the Livermore Air Quality Model
RPC:	Regional Planning Committee
SIP	State Implementation Plan
UTM:	Universal Transverse Mercator
VMT:	Vehicle Miles Travelled
USGS:	United States Geological Survey

Chapter 1

INTRODUCTION

The Clean Air Act Amendments of 1977 continue the requirement for State Implementation Plans (SIP) to be prepared to attain and maintain national ambient air quality standards. For a variety of reasons, the deadlines for submittal of the SIP's and the dates by which the plans are to demonstrate meeting the various air quality standards have been revised. Wherever possible, SIP's are to be shown meeting all applicable standards no later than 1982. For carbon monoxide and photochemical oxidants, under specific conditions, a five-year extension to 1987 is possible.

An important factor in determining what strategies are needed in an air quality plan is the level at which air quality standards are set. Recently, for example, the Environmental Protection Agency changed the photochemical oxidant 0.08 parts per million (ppm) - 1-hour standard to an ozone (O_3) 0.12 ppm - 1-hour daily standard. At the time the Bay Area non-attainment plan was adopted locally, the oxidant standard was still 0.08 ppm; therefore, the plan was developed to meet this standard. Although the standard has been changed to 0.12 ppm, the techniques used to develop the control strategy for the study are still valid. Currently, the Bay Area is re-examining its adopted plan to see what changes are appropriate. Other non-attainment areas may prepare plans for the new standard.

These reports have been prepared to assist those involved in preparing non-attainment plans for use in SIP submittals. Specifically, the reports deal with preparing photochemical oxidant or ozone control strategy plans. Depending on where a particular region is in the development of its plan(s), these guidance materials should be useful for the 1982 SIP submittals.

Volume I provides general guidance to non-attainment oxidant areas. This guidance is sufficiently broad in scope that all areas experiencing oxidant problems should find the report to be useful. Discussions are presented on the technical procedures for analyzing the oxidant problem and alternative control strategies. The intergovernmental coordination and public involvement required in the planning process are similarly described. A systematic approach to plan development is given. This approach acknowledges the widespread differences experienced across the nation in the extent and severity of oxidant air pollution. Three different levels of analysis are proposed depending on regional availability of data, staff and budgetary resources and overall schedules for plan preparation. These three levels of analysis vary in the degree of sophistication of the models employed for land use and transportation simulation, emission inventories, and oxidant predictions. They can be broadly characterized into three groups: complex, intermediate and simple models. The confidence and accuracy of technical analysis should be proportional to the degree of sophistication of the models used and the amount of effort expended in modeling. As conclusions and recommendations derived from the technical analysis are often important and costly, emphasis of this guideline is placed on analyses using complex or intermediate models to obtain more accurate results. The simple models, e.g., linear rollback, are discussed only for the purpose of preliminary assessment.

Volume II documents the results of a planning program to develop an oxidant plan for the San Francisco Bay Area during the period from 1976 to 1978. This volume is a detailed case study of the planning process, analysis procedures and development of final plan recommendations.

Volume II is intended primarily for air quality planners and/or technical personnel. As other non-attainment areas embark on similar planning programs, the recent experiences of the Bay Area should be instructive. The Bay Area efforts attempted to maintain an open and highly visible process for developing the plan. At the same time, the technical approach and analytical methodologies were as rigorous and objective as possible given the staff and budgetary resources available to the program. Throughout the plan development as both process and products were balanced, lessons were learned for conducting similar work in the future. The documentation of these lessons learned in the Bay Area--what to do and what not to do--is a major purpose of this report.

Chapter 2

PUBLIC AND LOCAL GOVERNMENT AND INTERGOVERNMENTAL COOPERATION

For decades the nine counties surrounding the Bay--San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, Solano, Napa, Sonoma and Marin--have been considered by inhabitants and others as a region. Regional governance has slowly developed for the Bay Area over the past two decades, although the philosophy of home rule remains well entrenched through legislative provision and long-established local practices and understandings.

Bay Area policymaking is a fragmented mixture of public and private actions. Within the public sector, it is a combination of Federal, State, regional and local governmental actions. For local government, it is a mixture of actions by myriad local agencies--large and small counties, large and small cities, regional special-purpose agencies, sub-regional districts, and hundreds of small suburban neighborhood "governments" (e.g., fire districts, sewer districts, etc.). No one agency provides a dominant voice in regional matters because the region has many single-purpose agencies with independent (and for the most part uncoordinated) regulatory authority and funding.

INTERGOVERNMENTAL COORDINATION

As the regional council of governments, the Association of Bay Area Governments (ABAG) is owned and operated by the cities and counties of the San Francisco Bay Area. ABAG is a voluntary, joint powers, comprehensive regional planning agency. It was established under the Joint Exercise of Powers Act (Government Code Sections 6500-6513) by the counties and cities within the San Francisco Bay Region. ABAG is the federally designated Areawide Planning Organization and Areawide Clearinghouse for this region.

During the fall of 1975 the Air Resources Board (ARB) organized a local Air Quality Maintenance Plan-Policy Task Force (AQMP-PTF) for the San Francisco Bay Region. This body was composed of elected officials and representatives of various public and special interest groups of the Bay Area. The AQMP-PTF was organized to ensure local involvement and support in the development of an implementable and acceptable air quality plan for inclusion in a revised State Implementation Plan (SIP). This basic approach was taken in light of several unsuccessful attempts in the early 1970s to implement various State and Federally proposed air quality control strategies. Local involvement was needed because many of the anticipated impacts of air pollution control strategies would affect decisions on the location, extent, timing and costs of areawide growth and development.

For several months the AQMP-PTF met to discuss air quality problems and the work needed to prepare a plan to alleviate these problems. A preliminary AQMP work plan was prepared in December 1975. Several months previously, in the spring of 1975, ABAG was designated as the regional water quality planning agency under Section 208 of the Federal Water Pollution Control Act of 1972. The primary mandate as the water quality planning agency was development of solutions for the unresolved environmental problems within the region, with an emphasis on urban stormwater runoff. EPA, ABAG, California Air Resources Board and the California Water Resources Control Board, recognized the benefits of integrating the air and water quality planning efforts. Such an integrated approach would assure the use of common data bases. Also, it was determined that the public participation and local involvement aspects of the program could be best served by a single program. In early 1976, the task force established to oversee the air quality planning program transferred its tasks to the 46-member Environmental Management Task Force (EMTF), the formal policy advisory committee established by ABAG to oversee the development of the integrated Environmental Management Plan. This decision, and the subsequent work to prepare an AQMP for oxidant were very compatible with the forthcoming requirements and actions to be taken under the 1977 amendments. The initial AQMP was developed as part of ABAG's Environmental Management Plan, prepared under the guidance of a 46-member task force. The EMTF included 23 local elected officials, representatives of 8 regional environmental agencies, 13 special and public interest groups, a State legislator and a congressman.

The task force itself technically served an advisory function for plan development and the first stage of plan implementation. As such, its responsibilities included recommending a final plan to each implementing agency's policy board; the task force also described to these policy boards the actions to be taken by other potential implementing agencies.

A number of other devices were used to influence the policymaking process, and to ensure the representation of a broad range of views by various interests throughout the metropolitan San Francisco community. A task force Public Participation Committee provided a forum for "citizens-at-large" perspectives concerning vital issues raised during the planning process. Still another group was the Plan Implementation

Committee, formed to evaluate the capabilities of existing governmental organizations (including planning process participants) recommended to have implementating responsibilities. Within ABAG the following bodies had important roles:

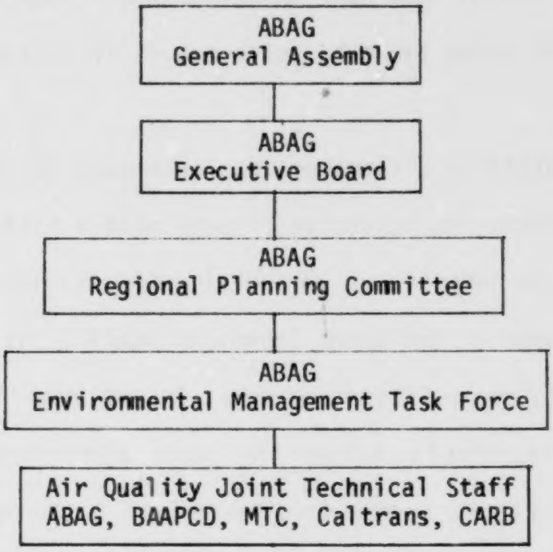
- Regional Planning Committee (RPC) - A permanently established ABAG committee with diverse planning objectives including preparation of a comprehensive regional plan. Regarding the Environmental Management Plan and work of the EMTF, the responsibilities of RPC were to ensure consistency among the policies and actions adopted for environmental protection with other policies already adopted by ABAG in other planning programs--housing, natural resources, open space, economic development.

- ABAG Executive Board - The governing body of ABAG, composed of elected city and county representatives of member jurisdictions. The Executive Board is the legal entity responsible for receiving contracts, certifying Environmental Impact Reports, holding public hearings on the Environmental Management Plan. Membership on the Executive Board is establised in the ABAG By-laws with representation partially weighted by population. The Executive Board has 34 voting members with 22 for cities and 12 members for the counties.

- ABAG General Assembly - As the name implies, the General Assembly is the complete membership of ABAG with each city and county being individually represented. A majority of the cities and a majority of the counties must approve an action(s) before it is enacted by the General Assembly. The General Assembly meets at least annually and more often if necessary.

Figure 2-1 shows the relationship of the various ABAG policy bodies to staff in the development of the air quality and environmental management plans.

Figure 2-1. Relationship of ABAG
Policy Bodies to Joint Techincal Staff


ABAG
General Assembly
ABAG
Executive Board
ABAG
Regional Planning Committee
ABAG
Environmental Management Task Force
Air Quality Joint Technical Staff
ABAG, BAAPCD, MTC, Caltrans, CARB

Another way of assuring participation and coordination in the development of the initial plan was through a series of technical advisory committees. An Assessment Advisory Committee, comprised of representatives of many potentially affected private interests, environmental interest groups and the general public, had the responsibility of devising a checklist and procedures for the systematic impact assessment of the proposed measures and strategies. The checklist was approved by the EMTF and used for all elements of ABAG's Environmental Management Program.

To ensure a sound technical approach offering a rational analysis of air quality problems and proposed solutions, an AQMP Advisory Committee was formed. That committee provided a sounding board for discussions concerning how various results are derived analytically. Methodologies, issues and background technical information were also presented to this group. The committee's function was crucial in terms of its role of assuring that a sound, technically competent assessment of air quality problems had been accomplished. Such information was vital to the actions being taken by policymakers in seeking solutions to these problems.

A responsive staffing arrangement was necessary to assist the task force in accomplishing its objective of providing a final plan product. To accomplish such an objective, an interagency technical staff was created. The purpose of the Joint Technical Staff (JTS) was to provide technical support to the policy structure. The JTS was conceived as a mechanism to effectively guide the work contributions of each participating agency toward the development of a coordinated set of strategies for policy evaluation. Since several of the agencies contributing personnel to staff have existing air pollution-related planning responsbility, a basic task of the JTS was to ensure a sufficiently broad non-attainment planning program to complement (rather than duplicate) the efforts.

The JTS was an interdisciplinary team of scientists, engineers and planners. The staff arrangements were created informally and later recognized in a memorandum of understanding, and other forms of interagency agreements. Personnel from the Bay Area Air Pollution Control District, the Metropolitan Transportation Commission and ABAG formed the core of the JTS. Other participants included representatives from the Caltrans, ARB, and EPA Region IX.

The JTS coordinated technical tasks among agencies participating in the planning process. It also guided the emission inventory development effort and a comprehensive air quality analysis to determine appropriate levels of control necessary to attain federal standards. The team also evaluated specific strategies for accomplishing those levels.

In addition to program coordination, the JTS had the responsibility for plan development documentation. All background materials--issue papers, briefs and technical memoranda pertinent to the revised SIP--were prepared by, or channeled through this particular group. It was also responsible for integrating all relevant technical materials into final plan product.

The interagency staff effort was supported through several direct and indirect funding arrangements from all levels of government. In addition to direct financing from state and federal sources, a number of local governments provided "in-kind" services by way of personnel, office space, supplies, equipment, etc. While these multifunding arrangements made it difficult to manage the SIP revision effort, they were beneficial in that all participating agencies were required to make more than a philosophical commitment to the planning program.

The JTS met as needed to schedule work, review assignments and overall progress and to discuss other programmatic issues. On the average, the JTS met every other week for about two hours. Two other staff groups were formed to facilitate certain aspects of the technical work and to provide the necessary interface of the staff work to the policy bodies. These groups were: 1) the interagency management committee, and 2) the modeling committee.

The interagency management committee was a three-member group comprised of senior management from ABAG, BAAPCD and MTC. Specifically, it was the Associate Executive Director of ABAG, the Deputy Air Pollution Control Officer of BAAPCD, and the Deputy Executive Director of MTC. The interagency management committee met on an ad hoc basis for several purposes. First, they met to provide overall guidance and direction to the JTS, especially regarding each agency's policies. The interagency management committee acted as a quasi-policy body anticipating what the reactions would be of the respective policy boards. The committee made suggestions to the JTS on work tasks and discussed appropriate strategies for timing, content and presentations of the technical analysis. In addition to facilitating the work assignments and assuring the necessary priorities and staff commitments were made for completing the work in a timely manner, the management committee also ensured that a consistent position was taken by the three agencies in the joint planning effort.

The modeling sub-committee was established to ensure objectivity and credibility to the air quality modeling tasks. In particular, it was set up to ensure a broad participation, especially from reviewing agencies, on the technical assumptions and approaches being used for modeling work. The various organizations which served on the modeling sub-committee were:

- ABAG
- BAAPCD
- MTC
- Caltrans
- CARB (Modeling Group-Sacramento)
- EPA - IX (Modeling Group)
- Lawrence Livermore Laboratory (LLL)
- Systems Applications, Inc. (SAI)

The latter two organizations, LLL and SAI, have both been active in model development and applications. They provided invaluable assistance on the appropriate use of the models, important technical assumptions and interpretation of results.

The modeling sub-committee also met on an ad hoc basis, typically no more than once per month, to review a variety of modeling tasks. An important function of the modeling sub-committee was to ensure openness to many work tasks which might later be criticized because of some assumption made. Whenever possible, the group attempted to arrive at a consensus on the modeling approach, assumption and for interpretation of result. At each step, limitations of the work and uncertainty were explicitly discussed and in many cases documented.

Another important body for the air quality plan development was the Program Review Board (PRB). The PRB was established to provide the necessary Federal and State guidance to the environmental management plan development. It included representatives from the following agencies:

- U.S. Environmental Protection Agency - IX
- State Water Resources Control Board
- State Air Resources Board
- State Solid Waste Management Board
- State Office of Planning and Research
- San Francisco Regional Water Quality Control Board

Another function of the PRB was to provide a forum for discussion of integrated environmental management issues. Because the Federal and State programs are organized according to separate media (i.e., air, water, solid waste) and the ABAG approach was integrated environmental planning, it was necessary to meet regularly with the Federal and State review agencies to receive consistent guidance. This body was frequently as informative to the separate agencies for program updates as it was to ABAG for policy guidance.

PUBLIC PARTICIPATION

A variety of approaches and techniques were used to keep the public informed of the program's progress. Written materials were prepared for different audiences. For example, press releases were available for the TV, radio and newspaper media covering the environmental management program and summaries of the technical materials for the public were mass produced for widespread distribution. Technical and detailed reports were available in limited quantities and served primarily as background materials for the advisory committees or as technical support documentation. Several mailing lists were maintained for receiving various publications as well as meeting notices.

Another method for distributing the air quality and other environmental management materials was in local libraries. A dozen libraries throughout the region cooperated as depository libraries for all the ABAG environmental materials. This mechanism provided ready access to the entire public of many backup documents and special reports. The libraries also served as convenient locations to have the draft Environmental Impact Report on file for inspection.

In addition to the written materials, many presentations were made to many different groups and organizations. A partial listing of these types of groups is given below:

o Environmental (e.g., Sierra Club, Lung Association)

- Business (e.g., Bay Area Council)
- Industry (e.g., Peninsula Manufacturers Association, Bay Area League of Industrial Associations)
- Civic (e.g., League of Women Voters, Walnut Creek Chamber of Commerce)
- Professional (e.g., Air Pollution Control Association, American Society of Civil Engineers)
- Governmental (e.g., city councils, county board of supervisors' meetings, special districts)

Over the two year period, hundreds of small and large community and other special meetings were held to describe progress on developing an air quality, water quality and solid waste management plan. When the draft plan was released in December, 1977, hundreds of more meetings were held to describe the plan, why it was prepared and the recommendations. ABAG conducted an extensive public participation program to keep the public informed of important (and frequently controversial) environmental decisions facing the region, including those for air quality.

STATE AND LOCAL CONSULTATIVE PROCESS

In California, the Air Resources Board (ARB) is the state agency responsible for meeting all requirements of Federal law relating to air pollution control. The ARB is obligated to initiate a "satisfactory process of consultation with local governments" pursuant to recent Clean Air Act Amendments.

For purposes of consultation, the ARB's participation in local planning takes place at both a policy and technical level. Policy involvement includes determining jointly with local elected officials the intergovernmental distribution of planning responsibilities, providing interpretation of State policy requirements and monitoring the local policy-making process. At the technical level, ARB staff participates in the development of planning assumptions and considerations, familiarizing themselves with such factors, and facilitating plan review.

In California, the ARB also assumes a primarily supportive role to local non-attainment planning. However, by virtue of its direct responsibility for vehicle emission controls, the ARB reserves some substantive planning responsibilities for itself. As a partner in the planning pro[illegible] the ARB has committed itself to actively participate in the technical planning process, as well as to consider proposed measures that will require State action.

By direct involvement in the local process, the ARB has also improved its efforts to meet state/local coordination requirements. In addition to traditional devices such as requiring periodic written progress reports from the local planning program, the ARB keeps abreast of the local effort by having participating staff located in the region. Both functions are carried out by ARB through interdisciplinary basin teams assigned to each planning process being conducted in the state.

The U.S. Environmental Protection Agency has maintained an active role in the San Francisco Bay Area. Its involvement primarily consists of providing interpretation of Federal policies for local planning programs. Other functions include technical and/or financial assistance to local governments for plan development. Of course the Federal role will vary from region to region and state to state. Some non-attainment areas may prefer to have EPA take a less active posture. EPA staff may become more involved in technical and/or policymaking aspects of the local plan development than they have in other areas. The extent of EPA involvement will depend both upon the localities' desire to have Federal advice and the particular regional EPA offices' capacity or desire to participate.

By January 1978, the San Francisco Bay Area, through its air quality maintenance planning efforts, had a well-developed organizational structure for its SIP revision planning process. Its specific approach, however, may not be workable in other regions of the country, particularly where other levels of government are more active in planning to resolve local problems. In such areas the state may assume major portions of the technical analysis. If this is the situation, a negotiation process should be created between the state and local participants--as envisioned by the 1977 amendments. It should be flexibly structured to permit adequate expression of local concerns and considerations during the planning process.

LOCAL LEAD AGENCY DESIGNATION

Section 174(a) of the 1977 Clean Air Act Amendments requires that, where possible, the implementation plan for a basin be prepared by an organization of local elected officials designated by agreement of the local governments in an affected area. To initiate the designation process in California, the Air Resources Board in 1978 identified non-attainment areas throughout the state, and notified local governments within them of the need to develop non-attainment plans. It also informed them that each non-attainment plan was to be developed through a cooperative effort involving both state and local governments. The first step of the process was the designation of a local lead agency to direct plan preparation.

The San Francisco region's air basin covers six counties and portions of three others. It was designated a non-attainment area, and local governments were notified of the need to develop a cooperative framework for non-attainment planning. Three organizations of local elected officials, the Association of Bay Area Governments (ABAG), the Bay Area Air Pollution Control District (BAAPCD) and the Metropolitan Transportation Commission (MTC) were potentially capable of being designated the local lead agency. MTC is the metropolitan planning organization designated to conduct transportation planning for the Bay Area under Federal and State transportation legislation. The BAAPCD is the regulatory air pollution control agency for the San Francisco Bay region, and ABAG is a regional council of governments that had nearly completed its responsibility for directing the Bay Area air quality maintenance planning process as required by Federal legislation of 1970. All three agencies cover the designated non-attainment area.

The 1977 Clean Air Act Amendments indicate a preference that the local lead agency be the air quality maintenance planning organization, the transportation planning organization or the organization with both responsibilities. In coordinating the preparation of an air quality maintenance plan, ABAG had already established a successful interagency organizational framework for air quality planning in the Bay Area. This experience provided the justification for ABAG to request lead agency designation by ARB for the San Francisco region's SIP revision effort. The BAAPCD also submitted a request for designation. However, in contrast with the ABAG bid, the BAAPCD requested a joint designation of ABAG, MTC, and itself.

To determine the most appropriate arrangement, ARB staff consulted local governments and also discussed the alternatives with the staffs of all three agencies. As a result, the executive officers of the agencies met to determine how they might work together to undertake the SIP revision planning effort. The discussions resulted in a statement of principles whereby specific responsibilities for each of the three agencies were defined for cooperatively undertaking the planning effort. Such responsibilities were formally documented in a joint Memorandum of Understanding early in the non-attainment planning process. According to the statement of principles, ABAG was to be the lead agency and to have principal responsibility for overall plan coordination. The agency was to provide the opportunity for MTC and BAAPCD to make significant contributions to plan development through policy input and technical support. The BAAPCD, MTC and ABAG approved the statement of principles and subsequently entered into a three-party Memorandum of Understanding to conduct air quality planning cooperatively. Based upon the statement, the Air Resources Board certified the ABAG as the local lead agency for non-attainment planning in the Bay Area.

JOINT DETERMINATION OF RESPONSIBILITIES

Many responsibilities originally to be determined jointly by the State and local elected officials in the Bay Area were left for local resolution via the joint Memorandum of Understanding. However, additional roles and responsibilities were generally defined by the state in the following manner: ABAG had the principal responsibility for overall plan development. Each agency was to contribute to plan development through participation in an interagency joint technical staff arrangement. Cities and counties were responsible for assessing their respective general plans and revising them as appropriate to assure conformity with the revised SIP. Finally, the state is to maintain responsibility for oversight, liaison with other non-attainment planning efforts in California, state policy interpretation as it relates to non-attainment planning, consideration of measures requiring state action, and final plan submission to the U.S. Environmental Protection Agency.

As lead agency, ABAG also has the responsibility of providing public and local policy involvement. Such involvement means the development of a plan for participation by local citizens throughout the Bay Area. It also requires the creation of a policy-making mechanism sufficiently representative of the broad diversity of viewpoints needed to determine a realistic course of action toward meeting prescribed air quality standards. The distribution of planning responsibilities is arrived at largely through negotiations between agencies.

With regard to ABAG, MTC and BAAPCD the allocation of such responsibilities are predetermined somewhat by the working relationships established between the agencies during their collaborative effort in developing an air quality maintenance plan for the Bay Area. During that effort, the BAAPCD assumed lead responsibility for developing baseline emission inventories, air quality modeling projections, and evaluating stationary source control options. The MTC performed baseline transportation system forecasts and evaluated transportation controls. Finally, ABAG developed the population, employment, and land use projections, which formed the basis of both the BAAPCD and MTC projections. These assigned areas of responsibility were not firmly established and could be changed to suit future planning efforts and goals.

Chapter 3

ORGANIZATION FOR THE TECHNICAL ANALYSIS

Analysis of alternative oxidant control strategies is a complex task, particularly when a grid-based photochemical model is the primary analytical tool. To quantitatively handle spatial and temporal variations in emissions under both existing and projected future conditions, as well as to simulate the effects of a wide variety of control strategies, a system of computer-based models was assembled.

In the plan development sequence from analysis to policy recommendations, the technical system was used to provide quantitative information in four critical areas:

1) The Baseline Projection - Both short range (1985)* and long range (2000)* estimates of oxidant air quality were made using a baseline projection that assumed the continuation of plausible regional growth trends, current local development policies, and existing or scheduled technological control regulations. By comparing the results of this projection with the Federal oxidant standard, the need for additional controls were determined;

2) Emissions Sensitivity Analysis - The sensitivity of projected future air quality to changes in hydrocarbon and NOx emission levels was tested to determine the approximate degree of emission reductions which would be necessary to meet the air quality standard (expressed in terms of tons of pollutants per day);

3) Effectiveness of Alternative Control Strategies - A broad spectrum of land use, transportation, and technological control alternatives was tested for effectiveness in improving future air quality;

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*It should be pointed out that attainment dates mandated by the Clean Air Act Amendments of 1977 are 1982 and 1987. 1985 and 2000 were selected for baseline projections in the study before the passage of the 1977 amendments. The recently revised AQMP for the San Francisco Bay Area has interpolated the results of 1985 projections to 1982.

4) Assessment of Alternative Control Strategies - The assessment of the air quality strategies tested involved the identification, and quantification where possible, of the potential impacts in four general areas of interest: environmental, financial/institutional, social and economic.

Models from four agencies--ABAG, MTC, BAAPCD, and LLL--made up the technical modeling system. The models were coordinated in terms of their inputs and outputs, data bases and consistency of assumptions. The modeling system was organized into four groups of models as shown in Figure 3-1:

- Population, employment, housing, and land use models maintained by ABAG (3-1);
- Travel demand models maintained by MTC (3-2, 3-3);
- Emission inventory disaggregation models maintained by BAAPCD and ABAG (3-4) (see Chapter 5);
- Livermore Regional Air Quality Model (LIRAQ) maintained by BAAPCD and LLL (3-2).

Figure 3-2 is a more detailed representation of the system components.

The models first projected and distributed a number of variables in space and time: population, employment, housing, land use, and transportation. These variables were used to estimate emissions by the major source categories. The Livermore Regional Air Quality Model (LIRAQ), which is a grid-based photochemical diffusion model, then combined these emissions along with information about the Bay Region's meteorology and topography to generate estimates of regional air pollution concentrations for the base year (1975), the short term (1985), and the long-term (2000).

Figure 3-1

OVERVIEW OF AQMP MODELING SYSTEM

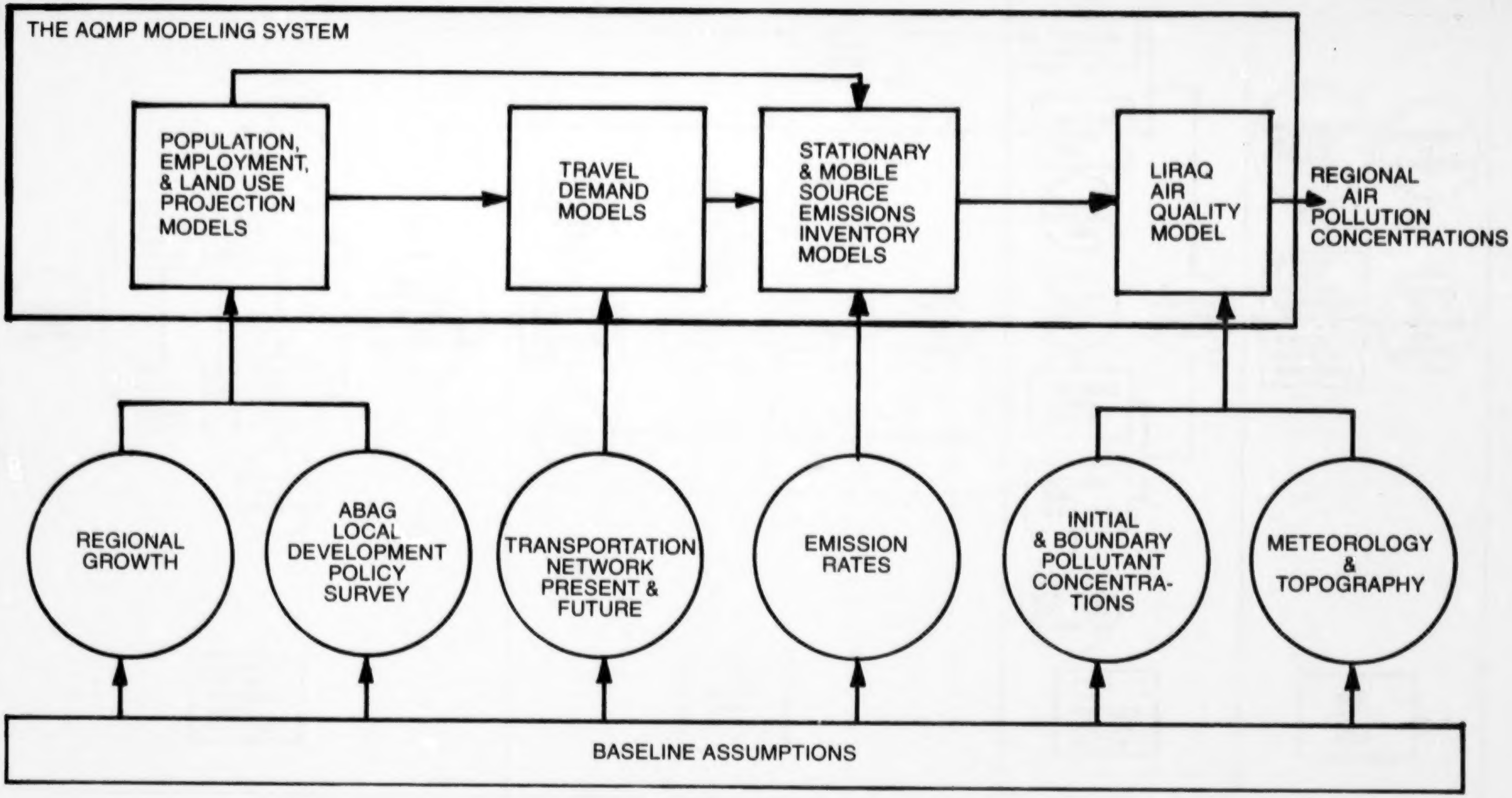
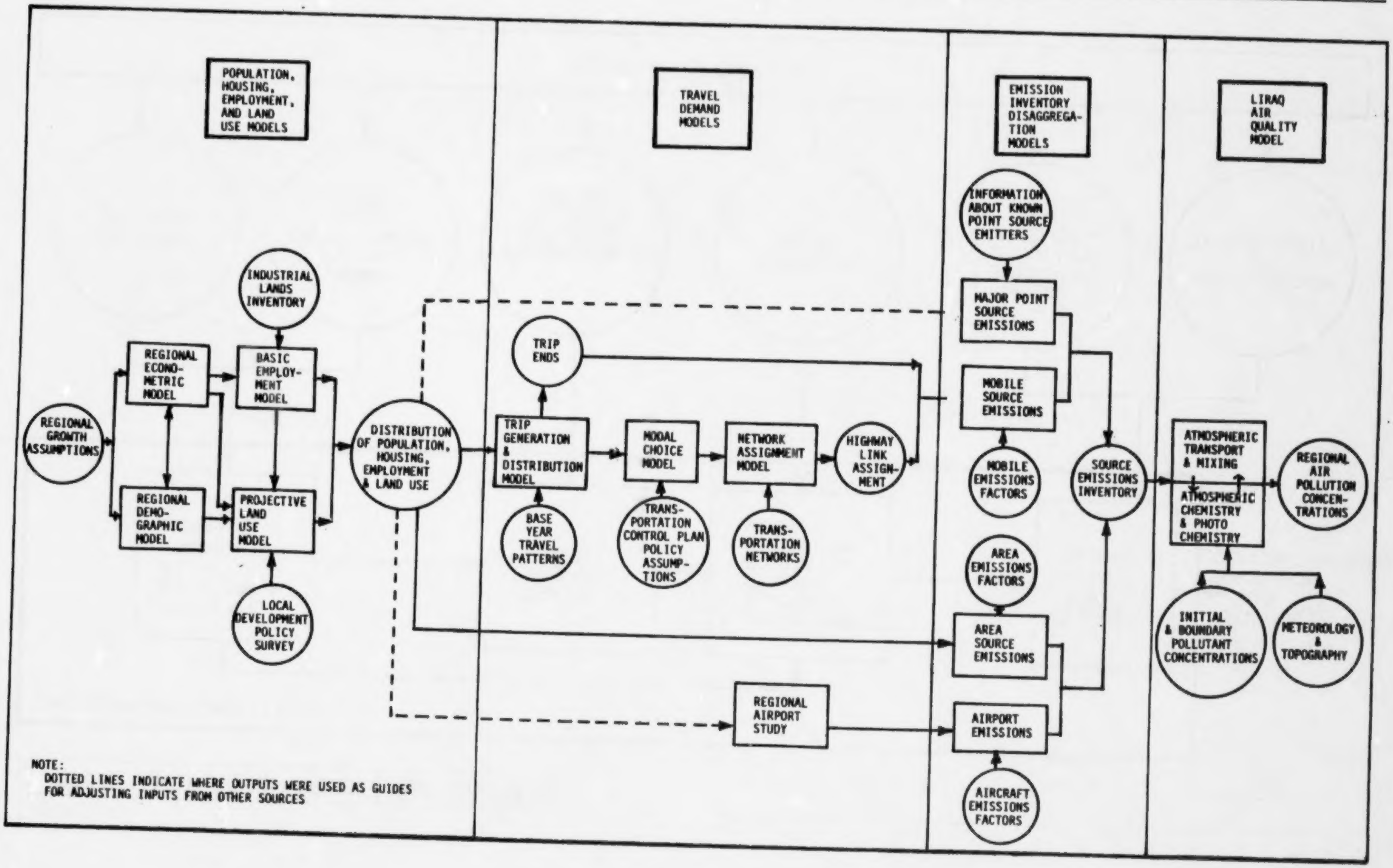

THE AQMP MODELING SYSTEM
POPULATION, EMPLOYMENT, & LAND USE PROJECTION MODELS
TRAVEL DEMAND MODELS
STATIONARY & MOBILE SOURCE EMISSIONS INVENTORY MODELS
LIRAQ AIR QUALITY MODEL
REGIONAL AIR POLLUTION CONCENTRATIONS
REGIONAL GROWTH
ABAG LOCAL DEVELOPMENT POLICY SURVEY
TRANSPORTATION NETWORK PRESENT & FUTURE
EMISSION RATES
INITIAL & BOUNDARY POLLUTANT CONCENTRA-TIONS
METEOROLOGY & TOPOGRAPHY
BASELINE ASSUMPTIONS

Figure 3-2

THE AQMP MODELING SYSTEM


POPULATION, HOUSING, EMPLOYMENT, AND LAND USE MODELS
TRAVEL DEMAND MODELS
EMISSION INVENTORY DISAGGREGATION MODELS
LIRAQ AIR QUALITY MODEL
REGIONAL GROWTH ASSUMPTIONS
REGIONAL ECONOMETRIC MODEL
REGIONAL DEMOGRAPHIC MODEL
INDUSTRIAL LANDS INVENTORY
BASIC EMPLOYMENT MODEL
PROJECTIVE LAND USE MODEL
LOCAL DEVELOPMENT POLICY SURVEY
DISTRIBUTION OF POPULATION, HOUSING, EMPLOYMENT & LAND USE
TRIP ENDS
TRIP GENERATION & DISTRIBUTION MODEL
BASE YEAR TRAVEL PATTERNS
MODAL CHOICE MODEL
TRANSPORTATION CONTROL PLAN POLICY ASSUMPTIONS
NETWORK ASSIGNMENT MODEL
TRANSPORTATION NETWORKS
HIGHWAY LINK ASSIGNMENT
REGIONAL AIRPORT STUDY
INFORMATION ABOUT KNOWN POINT SOURCE EMITTERS
MAJOR POINT SOURCE EMISSIONS
MOBILE SOURCE EMISSIONS
MOBILE EMISSIONS FACTORS
AREA EMISSIONS FACTORS
AREA SOURCE EMISSIONS
AIRPORT EMISSIONS
AIRCRAFT EMISSIONS FACTORS
SOURCE EMISSIONS INVENTORY
ATMOSPHERIC TRANSPORT & MIXING
ATMOSPHERIC CHEMISTRY & PHOTO CHEMISTRY
REGIONAL AIR POLLUTION CONCENTRATIONS
INITIAL & BOUNDARY POLLUTANT CONCENTRATIONS
METEOROLOGY & TOPOGRAPHY

NOTE:
DOTTED LINES INDICATE WHERE OUTPUTS WERE USED AS GUIDES FOR ADJUSTING INPUTS FROM OTHER SOURCES

Given the wide variety of human activities that give rise to air pollution, any projection of future air quality must account for changes in these activities as well as changes in the technology of air pollution control.

ABAG'S POPULATION, HOUSING, EMPLOYMENT AND LAND USE MODELS

The process of determining present and future hydrocarbon and NO_x (oxides of nitrogen) emissions begins with the distribution and size of urban activities. The ABAG models provide a set of population, housing, employment, and land use projections for the nine county San Francisco Bay Region. The projections are made from 1975 to 2000 in five-year intervals. Additionally, they are spatially allocated to a system of 440 subregional zones which cover the region, as shown in Figure 3-3. Each zone is composed of one or more census tracts.

As shown in Figure 3-2, the ABAG projection system is comprised of four major models:

- Regional demographic model - projects regional population, households, and labor force;
- Regional econometric model - projects regional basic and local serving employment;
- Basic employment model (BEMOD) - allocates basic employment to 440 zones;
- Projective land use model (PLUM) - allocates population, households, and local serving employment to 440 zones.

The regional demographic and econometric models were first operated to produce regional projections, or control totals. These control totals were then allocated to the 440 zones using BEMOD and PLUM. Initially, the regional assumptions were varied to yield a range of

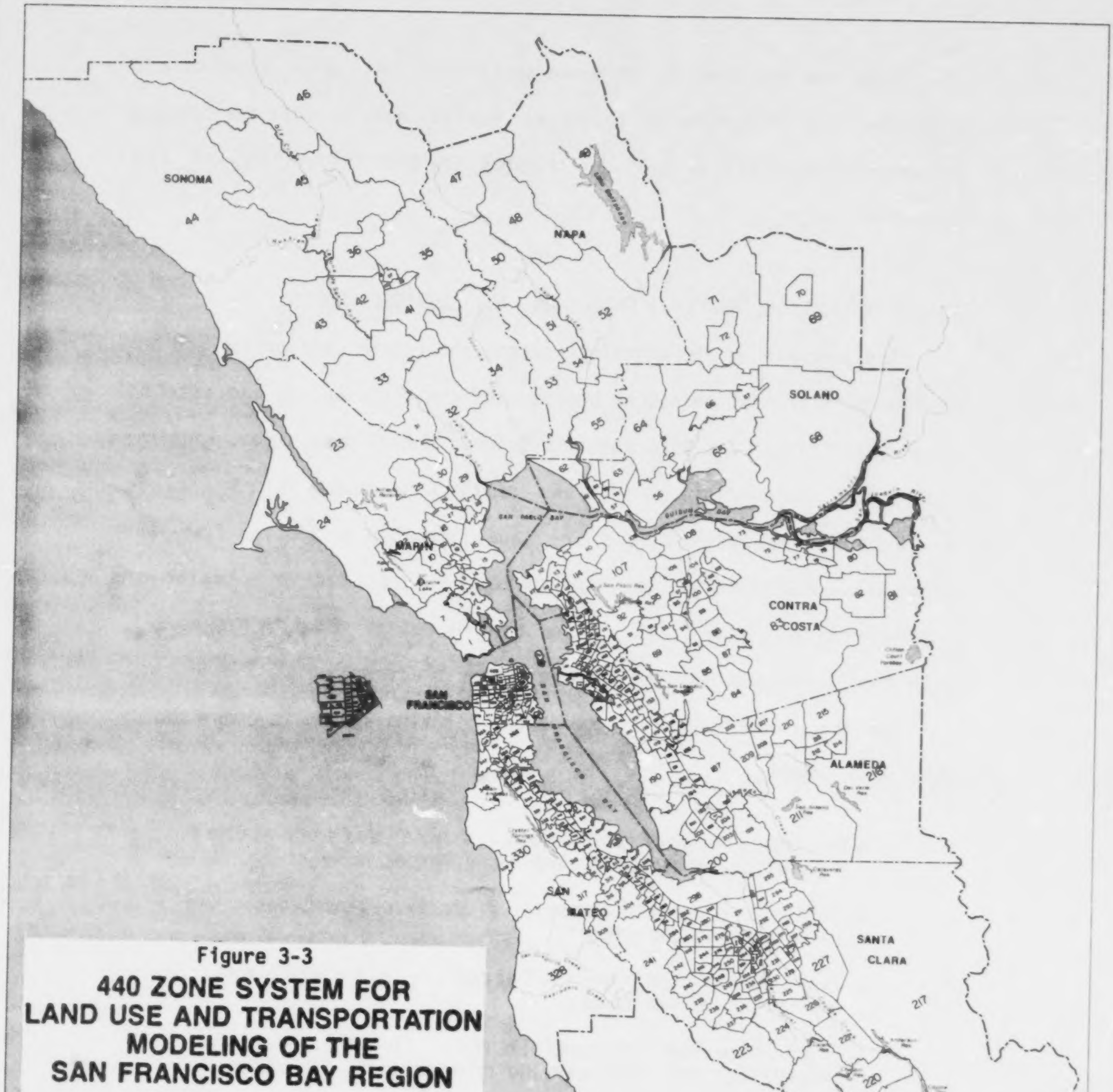

SONOMA
NAPA
SOLANO
MARIN
CONTRA COSTA
SAN PABLO BAY
SUISUN BAY
SAN FRANCISCO
SAN FRANCISCO BAY
ALAMEDA
SAN MATEO
SANTA CLARA

Figure 3-3

440 ZONE SYSTEM FOR LAND USE AND TRANSPORTATION MODELING OF THE SAN FRANCISCO BAY REGION

projections; later, the subregional land use assumptions were modified to yield different distributional patterns.

At the regional level, the demographic model combined assumptions regarding fertility, mortality, migration, household headship, and labor force participation to produce projections of population, households and labor force. The econometric model combined assumptions about the regional industrial structure and projections of national industrial growth to produce projections of employment for fourteen basic and four local-serving employment categories. Several iterations of the two regional models were required in order to balance the labor force projections from the demographic model with the employment projections from the econometric model.

The regional projections were then allocated to the subregional zones. BEMOD first allocates the fourteen basic employment projections. This allocation was based on the location of existing industry, an inventory of available land for industrial development, and characteristics of the land which influence its attractiveness such as services and accessibility. PLUM then combined this distribution of basic employment along with the regional control totals to allocate population, households, and local-serving employment to zones.

The major controlling assumptions for the subregional allocation were provided through a 1976 survey of local land development policies. The cities, counties, and special districts in the region were surveyed to determine their current policy instruments in force--i.e., their legal, financial, and administrative means--for encouraging or restricting development. These same policies were subsequently modified to test a "compact growth" land use management strategy.

The resultant distribution of population, households, employment and related land use were supplied to the travel demand and emission inventory models.

THE TRAVEL DEMAND FORECASTING SYSTEM

The travel demand forecasting models, maintained and operated by the Metropolitan Transportation Commission (MTC) provided two key outputs for air quality evaluation: a trip table indicating the number of daily trips originating and ending in each 440 zone, and a coded highway network indicating traffic volumes and average speeds on each highway segment in the network. Primary inputs to these models included the distribution of urban activities from the ABAG projection system; base year travel patterns, present and future transportation networks and transportation control plan assumptions. The trip ends and highway link assignments are used by the emission inventory disaggregation models to generate mobile source emissions. Additionally, MTC performs regional airport planning which was used to estimate airport emissions.

The MTC system has four major models which are common among travel demand models:

- Trip Generation Model - Trip generation is the process of relating a number of trip origins and destinations to characteristics of the population and land use. Based on the population, housing, employment, income and land use characteristics of the various zones within the region, the trip generation model specifies the number of daily trips beginning and ending in each zone.
- Trip Distribution Model - Trip distribution is the process by which trips originating in each zone are distributed to the 440 zones in the region (including the zone of origin). Primary factors influencing the distribution are the growth of land use and urban activities within particular zones and the transit and highway accessibilities among the zones.

- Modal Choice Model - The proportion of total daily trips that would be made as auto driver; auto passenger, and transit rider are determined by the modal choice model. This model incorporates the behavioral characteristics of the trip makers in terms of their responses to time and monetary costs associated with each trip. These costs are estimated for each alternative network depending upon the highway and transit facilities and services specified.

- Network Assignment Model - Network assignment is the process of routing trips to specific highway and transit links. This model allocates the trips to the pre-specified highway and transit networks to determine specific volumes and transit ridership in specific areas.

EMISSION INVENTORY DISAGGREGATION MODELS

The Bay Area Air Pollution Control District (BAAPCD) and ABAG collaborated to develop the emission inventory disaggregation models. The emission categories have been grouped into four major categories for input to LIRAQ-stationary point, area, mobile, and airport emissions. The models are described below (see Reference 3-4 for a more detailed description of emission inventory procedures):

- Stationary Point and Area Source Emissions - Stationary sources are divided into point and area source categories as a means of reducing the effort required to account for all of the individual sources. Those sources which emit a relatively large amount of pollutants are accounted for individually and are referred to as major point sources. Emissions from the more numerous smaller emitters are estimated in a collective fashion for an entire source type, such as domestic space heaters.

  The basic procedure for projecting future emissions is the same for both stationary point and area source categories. The growth or decline of activity for a given source category is, in most cases, assumed to be related proportionally to changes in one or more of the variables in the ABAG projections. For example, chemical processing emissions are assumed proportional to employment in the chemical processing industry, while domestic fuel combustion emissions are assumed proportional to population. In addition to the basic assumption of proportionality, changes in the emission rate per unit of activity for a given source category may be superimposed to account for improvements in control technology or changes in the type of fuel used.

- Motor Vehicle Emissions - Vehicular activity data from the MTC travel demand modeling system is divided into five basic categories:

  - auto trip-making activity by the 440 zones
  - auto travel by link
  - gasoline truck travel by link
  - diesel truck travel by link
  - motorcycle travel by link

  This division is required because each of the vehicle types has different sets of emissions, vehicle population, and age distribution data. In the particular case of automobiles, an additional category of trip-related emissions (cold start, hot start and hot soak) has been included so that separate spatial and temporal accounting of trip-end related emissions may be made.

- Aircraft Emissions - Three general categories for aircraft (commercial carriers, military, and general aviation) were established based on availability of aircraft activity data. Base year commercial carrier emissions were estimated using comprehensive flight schedules for each airport in the region. Emissions from military operations were based on fuel usage data, while general aviation emissions were estimated based on selected individual airport records. Future year emissions were based primarily on MTC's Regional Airport Study.

LIVERMORE REGIONAL AIR QUALITY MODEL (LIRAQ)

The set of computer codes, which together comprise the Livermore Regional Air Quality (LIRAQ) model, have been developed as an operational tool to assist in tasks such as assessing the compliance of present air quality with Federal ambient air quality standards, evaluating the impact on regional air quality of various land use alternatives, and predicting the effect on regional air quality of various emission control strategies.

The LIRAQ model attempts to treat most of the important factors that determine regional air quality as a function of time (3-5). The San Francisco Bay Area is characterized by both its complex topography and its changing meteorology. The region has quite intricate geographic features, including numerous ridges, hills, valleys, the Pacific Ocean, a central bay and major inland flats. Meteorological systems formed over the Pacific Ocean are influenced by the complex Bay Area topography to create complicated, temporally and spatially varying wind fields, and inversion base heights. The model treats both the complex topography and changing meteorology on one of the several available grid scales (1 km or greater) from which the user may choose to study a particular air quality problem. The model does not attempt to forecast tomorrow's air quality, because that would require the capability to forecast the regional meteorology, a formidable problem in itself. Instead, in LIRAQ, the meteorology (wind speed and direction, atmospheric transmissivity, and mixing depth) must be specified, either at measurement stations or by coordinates. Typically, this involves use of real meteorological situations (based on sets of previously acquired meteorological observations) that may be expected to be similar to future weather patterns.

The simulation of photochemical air quality is based on a 51-step reaction set. In addition, secondary species (those created through chemical transformation processes in the atmosphere) including ozone (O_3), nitrogen dioxide (NO_2) and others must be and are treated by the LIRAQ model.

Because of the complex and non-uniform characteristics of the Bay Area (and to some extent of every region) and because a regional pattern is needed instead of a measure of air quality at a specific point, the mathematical approach that has been used is based on the establishment of a fixed grid in the two horizontal dimensions. Because the depth of air through which pollutants mix is highly variable in space and time and in addition may intersect topography, the model has had to be limited to treatment of a single layer in the vertical. The height of this layer, however, may vary in space and time.

The LIRAQ model is thus capable of simulating the time-and-space varying concentrations of non-reactive and reactive pollutants on a regional basis using prescribed meteorology and source emissions.

SYSTEMS APPLICATIONS

The enormous number of variables potentially affecting future oxidant levels in a major metropolitan area such as the San Francisco Bay Region is one reason to use a computer-based forecasting system. Such an approach has two principal advantages: 1) it provides a systematic structure for organizing and accounting for a large number of variables; and 2) the system allows flexibility to test many alternative control strategies.

However, it was recognized that the models have certain limitations and were only partial representations of urban phenomena. To maintain consistency of assumptions and data bases and to oversee model development and the interpretation of results, two technical advisory committees were used--the AQMP and Projections Technical Advisory Committee. These committees met regularly over a two-year period to review, coordinate and guide the technical work leading to the staff prepared policy recommendations.

The models were controlled by various assumptions. A set of baseline assumptions were first specified for problem identification and as a starting point for testing alternative strategies. These assumptions are generalized in Figure 3-1. They begin with the regional growth assumptions regarding fertility, mortality, migration, the regional industrial structure, and the region's share of national industrial growth. At the subregional level, the major assumptions affecting the distribution of urban activities were supplied through a 1976 local development policy survey that identified the current policy instruments in force--i.e., the legal, financial, and administrative means--for encouraging or restricting development. Other information affecting the subregional distribution included an inventory of vacant industrial lands and transit and highway facilities and services.

The travel demand models used the distribution of urban activities along with transportation network system descriptions for the 1975 base and future years. The future year assumptions were provided by MTC staff through interpretation of the MTC regional transportation plan.

The emission inventory disaggregation models combined the distribution of urban activities and travel patterns along with assumptions about current and future technological controls. The baseline assumptions included only technological controls either currently in force or legally mandated.

Finally, the LIRAQ model used the emissions estimates, along with assumptions about meteorology and topography and initial and boundary pollutants concentrations. The specification of initial and boundary conditions for future year simulations was an important part of the analysis. Concentrations of pollutants at the boundaries of a metropolitan area are poorly known quantities, yet they have a significant influence on the results.

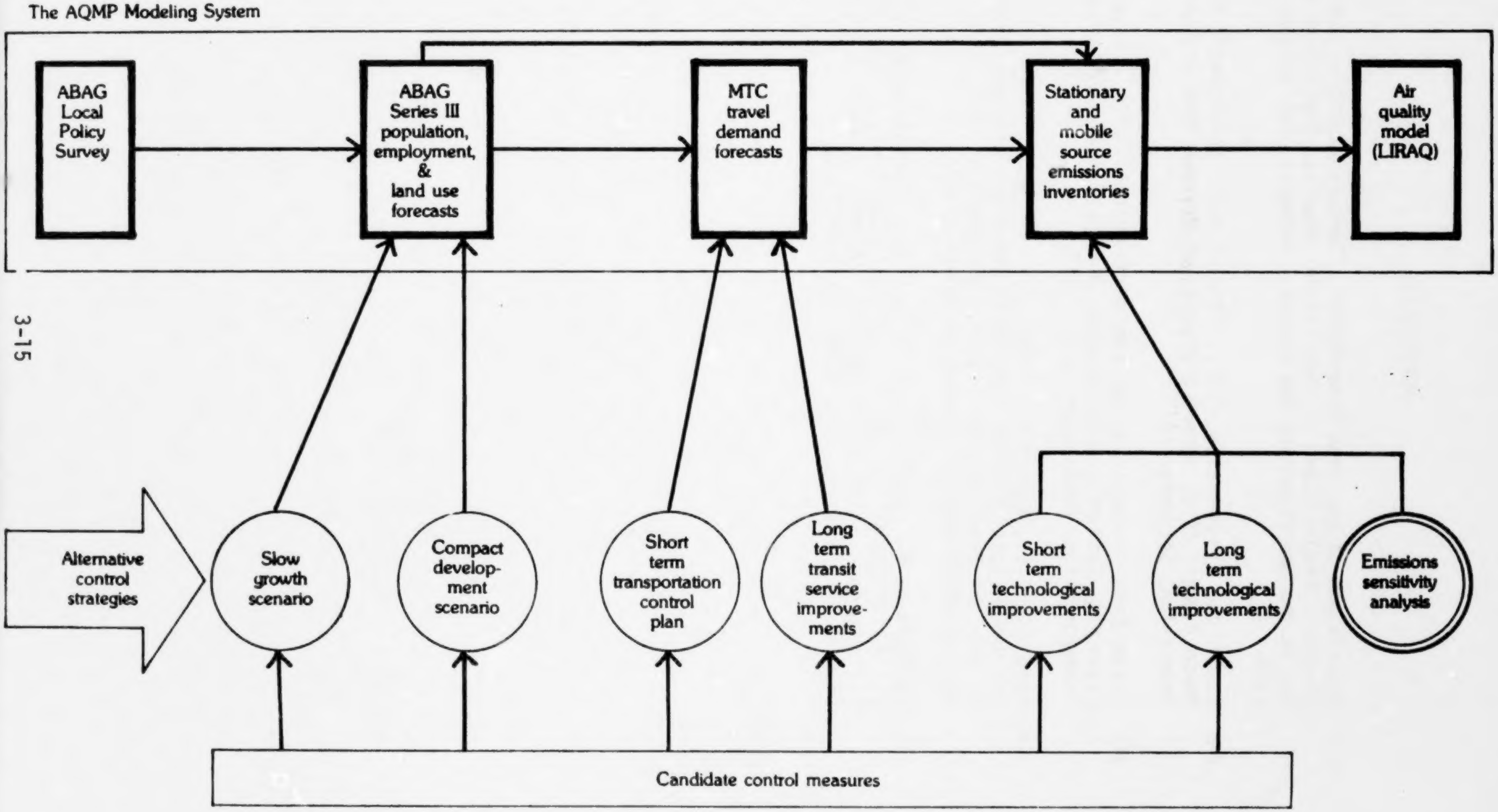
The preliminary recommendations resulting from the testing and assessment were then forwarded to the decision-making bodies for their consideration. Once the policy recommendations were made, limited reruns were made with the technical system due to the time required in relation to committee deliberations. The modified results, along with staff judgement, were used to determine the implications of the policy changes.

In Figure 3-4, each of the individual strategies are shown as they affected specific baseline assumptions described earlier. In the short term (1985) transportation controls (without land use measures) were tested. This was because it was assumed that the effect of land use measures, or "compact development," would be minimal in the short term. In the long term, transportation and land use measures were tested together. Land use actions were dependent on transportation improvements and vice versa.

The technological improvements for stationary and mobile sources were developed and their effects on emissions completed. Similarly, the effects of land use and transportation were analyzed directly by the ABAG and MTC models and then translated into emission changes. Emission inventories were reconstructed based on the control measures, and the resulting air quality was projected by LIRAQ.

Figure 3-4

Control strategy testing with the AQMP Modeling System


The AQMP Modeling System
ABAG Local Policy Survey
ABAG Series III population, employment, & land use forecasts
MTC travel demand forecasts
Stationary and mobile source emissions inventories
Air quality model (LIRAQ)
Alternative control strategies
Slow growth scenario
Compact develop-ment scenario
Short term transportation control plan
Long term transit service improve-ments
Short term technological improvements
Long term technological improvements
Emissions sensitivity analysis
Candidate control measures

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3-5 MacCracken, M.C., and Sauter, G.D., Eds., "Development of an Air Pollution Model for the San Francisco Bay Area" - Final Report to the National Science Foundation, Volumes I and II, Lawrence Livermore Laboratory, UCRL-51920, October 1975.

Chapter 4

THE AIR QUALITY PROBLEM

Photochemical oxidant, as the contaminant of initial and deepest concern in California has now been continuously monitored for 15 years by the BAAPCD. After peaking in 1965, the oxidant levels showed a clear downward trend for the past 11 years, despite large annual weather-induced fluctuations. Days exceeding the Federal one-hour standard of .08 ppm averaged 131 in the 1965-69 pentad and 85 in the 1970-74 pentad. For the 1975 base year there were 69 days over standard, and preliminary totals for 1976 show 65 days. Despite more than 50% improvement over the past decade, oxidant remains the largest and least tractable problem in terms of air quality maintenance.

For oxidant the maps in Figures 4-1 and 4-2 plot the number of days over standard in 1975, and for comparison the average values in the 1970-74 pentad. Both maps show minimum excesses (0 to 5 days) along the coast, but in 1975 the clean band had widened and extended further inland. Maximums in both cases are over the inland sheltered valleys, but there were two significant differences. First, the 1975 intensity of the maximum was 20% lower, decreasing from 60 to 50 days. 1976 data indicated a further weakening of this maximum to less than 35 days. Second, the center of the maximum had shifted from the Livermore Valley to the East Santa Clara Valley. (The 1976 data showed the center remaining as in 1975, but extending more toward Gilroy than toward Livermore.)

Since the formation of oxidant is highly weather-dependent, the District developed a "trend study" technique to damp out the primary

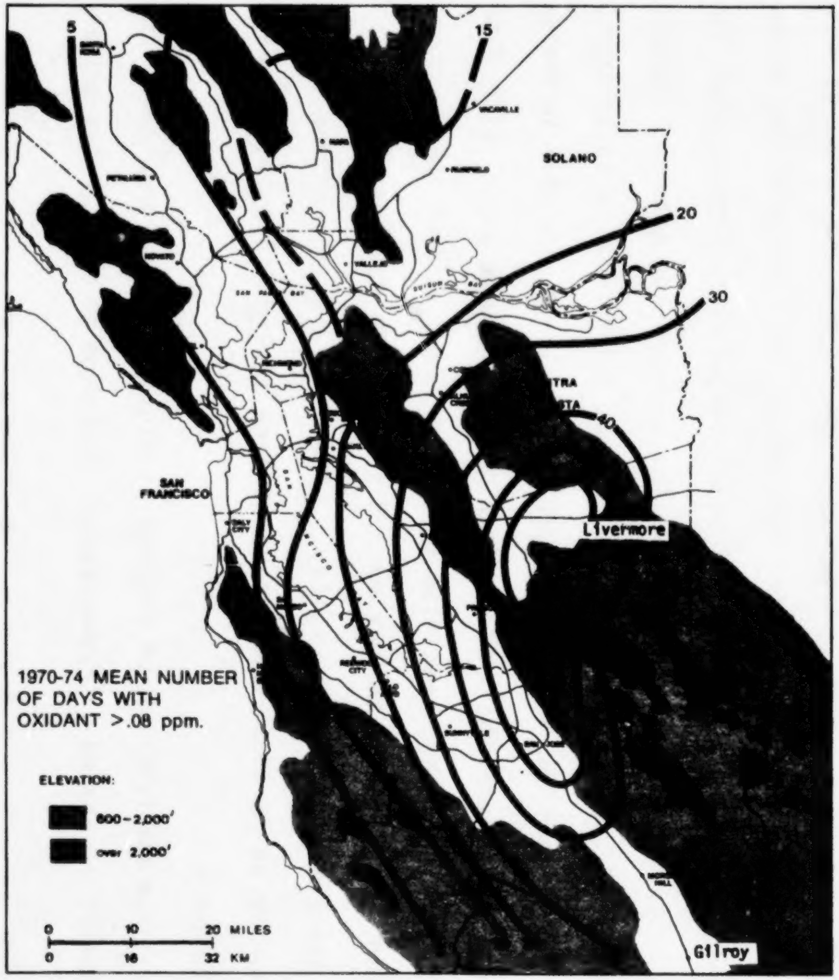

5
15
SOLANO
20
30
40
SAN FRANCISCO
Livermore
Gilroy
1970-74 MEAN NUMBER OF DAYS WITH OXIDANT >.08 ppm.
ELEVATION:
600-2,000'
over 2,000'
0 10 20 MILES
0 16 32 KM

Figure 4-1

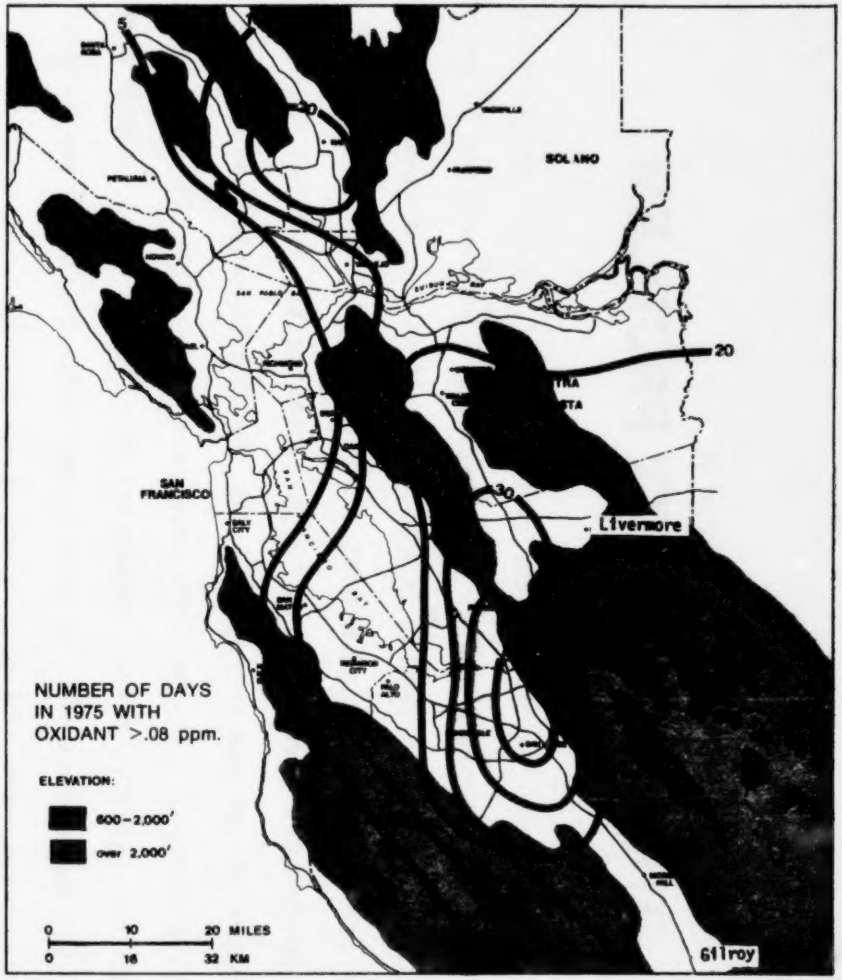

5
20
SOLANO
20
30
SAN FRANCISCO
Livermore
Gilroy
NUMBER OF DAYS IN 1975 WITH OXIDANT >.08 ppm.
ELEVATION:
600-2,000'
over 2,000'
0 10 20 MILES
0 16 32 KM

Figure 4-2

weather factors (temperature and inversion height) and compared the oxidant levels only for days when these conditions favored its formation. Results of this study (updated to include 1976) are shown in Figure 4-3. On oxidant-conducive days, the District average (for our 7 long-term stations) peaked at .10 ppm in 1965 and fell to .06 ppm in 1976. In 1971 this average fell below the Federal standard and has remained below it ever since. The two long-term stations with averages remaining over standard are San Jose and Livermore.

The southeastward migration of highest values over the years was another noteworthy feature of the oxidant trend graph. San Leandro led (with over .15 ppm) in 1964; Livermore led (with over .14 ppm) in 1968 and 1969; San Jose led (with .11 to .13 ppm) in 1974 and 1975. These highest station averages fortunately decreased at nearly the same rate as the overall District average. The reasons for the shift appeared to be related to the 15-year shifts in population and vehicle use, and to the changes in emission mix and emission patterns. Additionally, the increases in emissions of primary contaminants had been into the sheltered valleys topographically and meteorologically least favorable for mixing and dispersion.

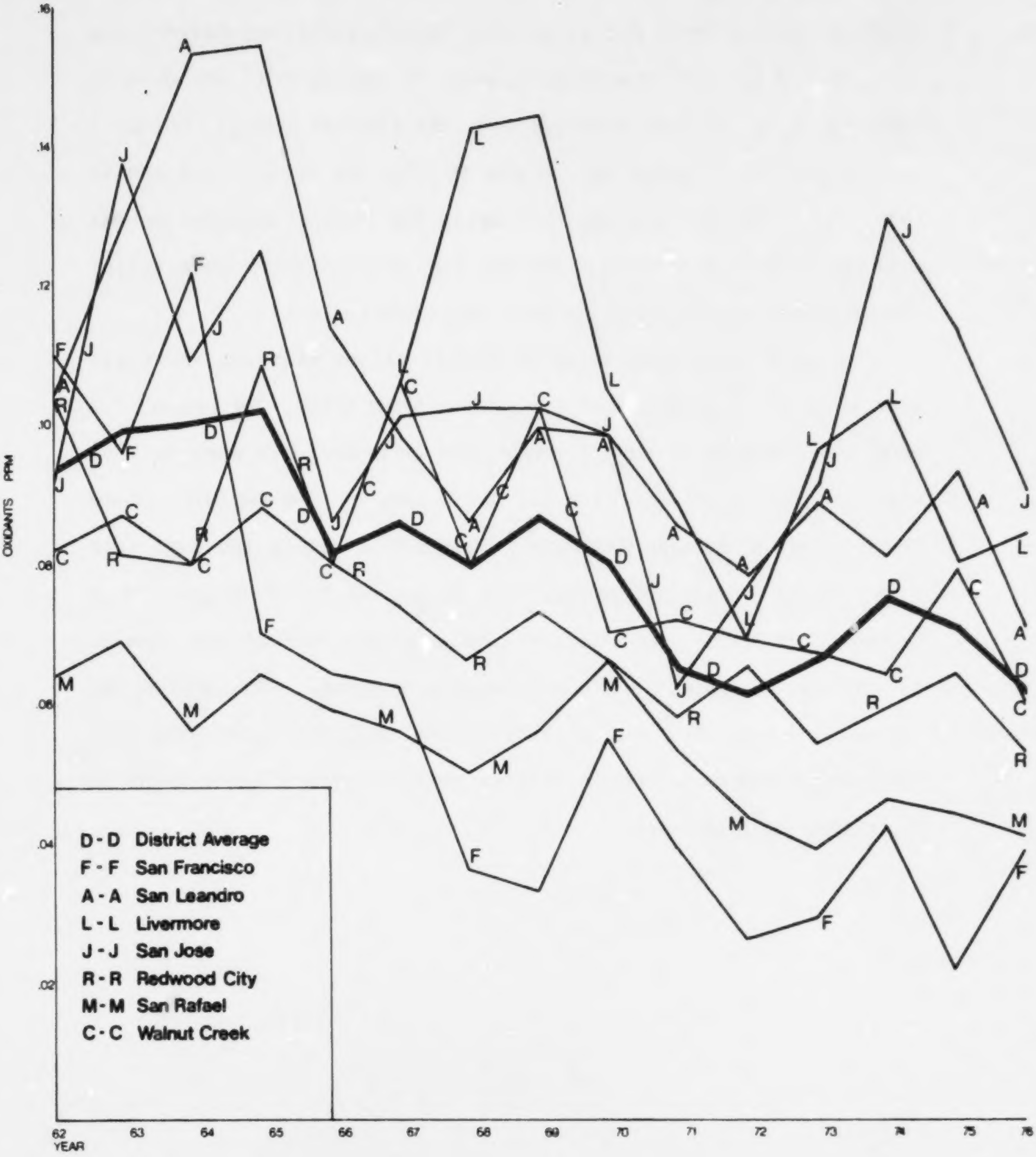


Figure 4-3

Trend of Average High-Hour Oxidant Concentrations For Days With Comparable Temperature & Inversion Conditions (April through October Photochemical Oxidant Seasons 1962-1976)

Chapter 5

COMPILING EMISSIONS INVENTORIES

Any systematic approach to air pollution control requires compilation of some kind of emissions inventory. The source inventory helps to define the problems in terms of which pollutants should be considered, which sources are important, and what control measures might be effective. An updated source inventory can be used, together with meteorological information, to model and predict ambient air quality effects for planning purposes.

Existing source inventories vary greatly in their detail, methodology, and accuracy, depending on the intended use and available resources. A typical source inventory might include ten or twenty source categories, with geographical distribution by county, and emission rate units of tons/day or tons/year. More detailed information on some major point sources may be compiled by local jurisdictions for internal use for EPA's National Emissions Data System/Emission Inventory Subsystem (NEDS/EIS).

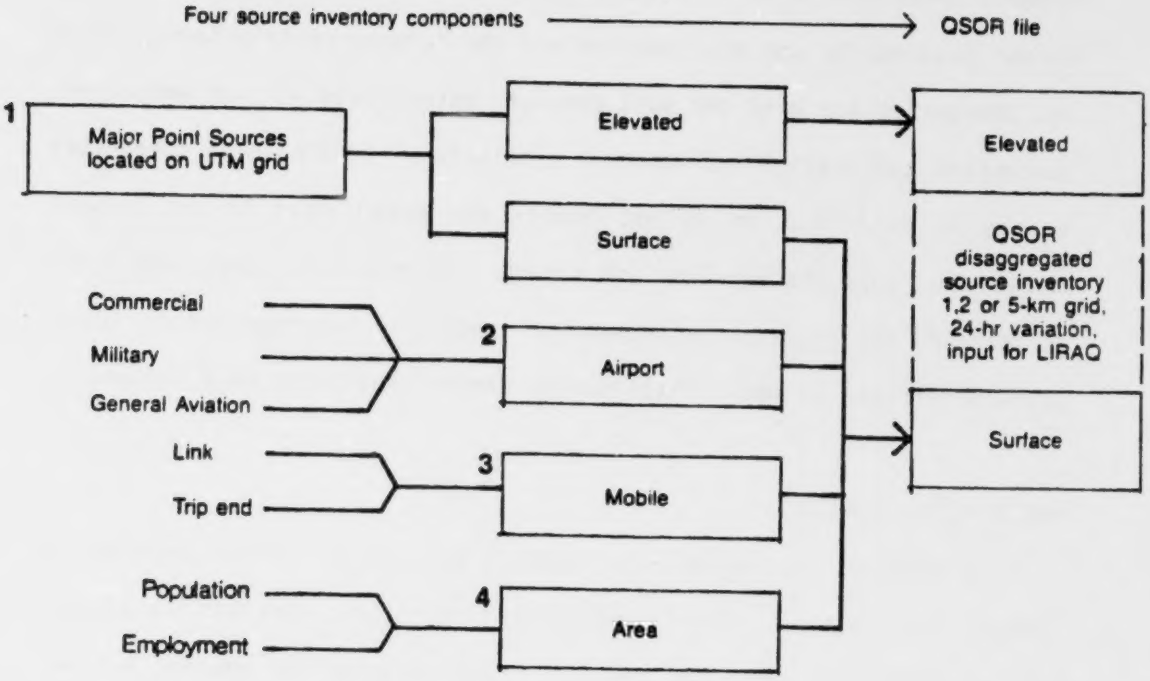
The BAAPCD source inventory (5-1) is relatively sophisticated in degree of detail, methodology and documentation. It includes, for example, 107 separate categories for source classification. The AQMP effort utilized this comprehensive inventory as a starting point for the modeling effort; however, extensive modifications and disaggregation were still needed to achieve the spatial and temporal resolution required for the LIRAQ model.

LIRAQ (5-2) is an Eulerian (grid-based) regional model. LIRAQ-2, the photochemical version is run with a 20 x 20 grid with squares 5 km on an edge. The total area covered in a given run is 100 km x 100 km or 10,000 km. Since LIRAQ can also be run on 1 km or 2 km grid squares, the original emission files are kept on a 1-km grid basis, then aggregated to an 2-km or 5-km basis, as needed. The total inventory area, excluding ocean, is approximately 20,000 sq km -- nine counties around the San Francisco Bay.

As shown in Figure 5-1 the LIRAQ source inventory is made up from four component parts, each part compiled with independent data sources and techniques. The four components are: major point sources, area sources, airports, and mobile sources. Major point sources include oil refineries, electric utilities, chemical industry, metallurgy, rock and mineral operations, etc.--any stationary source emitting more than 0.1 ton/day or 25 tons/year of any pollutant. Such sources are identified and listed separately in the existing source inventory, with accurate information on location, emissions, stack parameters, operation schedules, and process variability. Area sources, also called "population-distributed" emissions, include: domestic fuel combustion, off-road mobile sources, utility engines, and small stationary sources such as service stations, dry cleaners, small plastics manufacturing, etc. Emissions are estimated by a variety of techniques including direct measurement, natural gas use, solvent sales, gasoline sales, paint and resin use, etc. Airports include emissions from commercial, military and general aviation from 37 airports in the Bay area. Emissions are calculated with factors based on engine type, operating mode through a five-step landing and takeoff cycle, and traffic counts. Fuel consumption data is also considered. Mobile sources include cars, trucks, buses and motorcycles. Emissions include exhaust, crankcase,

Figure 5-1

Summary schematic of QSOR[a] file preparation.



Four source inventory components
QSOR file
1
Major Point Sources located on UTM grid
Elevated
Surface
Commercial
Military
General Aviation
2
Airport
Link
Trip end
3
Mobile
Population
Employment
4
Area
Elevated
QSOR disaggregated source inventory 1,2 or 5-km grid, 24-hr variation, input for LIRAQ
Surface

---

[a] QSOR is the code name for the final disaggregated source inventory file which serves as input to the Livermore Air Quality Model.

tire wear, and evaporative--during starting, over-the-road travel, and trip-end soak.

Table 5-1 shows the relative contributions of the four source inventory components for the 1975 baseline inventory. Focusing on the organic emissions, which are most important in oxidant control, it is clear that mobile and area sources are the largest contributors. These two categories are also the most complex, unfortunately, for emissions estimates and spatial and temporal resolution. It should be noted that errors in distribution do not change the total mass of pollutant emissions, only the location and timing. In this case, the LIRAQ model is intended for regional photochemical modeling (as opposed to local plume modeling), so small distribution errors should not be critical.

MAJOR POINT SOURCES

In general the major point sources present no serious problems in spatial distribution. One can pinpoint their locations with a street map and USGS map and read the UTM coordinates to the nearest 0.1 km. Major point sources are carried as separate listings and are further divided into "surface" and "elevated" categories, depending on the stack height. The dividing line is 100 feet. The elevated major point sources remain as individual listings in the final source inventory file, called QSOR (see Figure 5-1). Surface major point sources are merged with emissions from the other three source inventory components.

The hourly and seasonal process variations of major point sources are generally known. Because these are large individual emitters, they are subject to intense scrutiny from regulatory agencies. And by the nature of large operations, there are usually reliable internal process

Table 5.1 San Francisco Bay Area source inventory: four component breakdown as in QSOR[a] file preparation

Source Type	1975 Baseline Emissions (tons/day)				
	Organics	NO_x (as NO_2)	CO	SO_2	Particulate
Major point	129	192	80	198	19
Area	394	101	336	12	98
Airport	23	13	54	1	9
Mobile	467	390	3808	19	43
Total	1013	696	4278	230	169

[a] QSOR is the code name for the final disaggregated source inventory file which serves as input to the Livermore Air Quality Model.

records and accounting data available to serve as a basis for emission rate calculations. Electric utilities, for example, maintain detailed records of fuel consumption by boiler, and generator output by hour. Most major industries and businesses have records of production, fuel-use, work-shifts, etc., which are indicators of emissions variations. Major point source emissions for the chosen day are allocated by hour according to data of this kind, when available. If individual process records are not available, the source inventory engineer may estimate diurnal variations, based on his knowledge of the source operation.

AIRPORTS

Like major point sources, airports are also at known locations. Because some landing and take-off emissions are spread out within the mixing layer, airport emissions were distributed over neighboring grid squares. For commercial and military flights, emissions were distributed uniformly over all grid squares within 2 miles of the airport. For general aviation at community airports, a distance of 1 mile was used.

Aircraft emissions are divided into three source inventory classifications: commercial carriers, military, and general aviation. Commercial carriers are most important from an emissions viewpoint, and fortunately these are also the best documented. Comprehensive schedule books keep up-to-date listings of commercial flights to all the major airports of the world, with arrival and departure times and aircraft type. For this project, BAAPCD staff compiled data on commercial air carrier operations at Bay Area airports from the 1975 "North American

Air Guide." Temporal resolution factors for the three large airports (San Francisco, Oakland and San Jose) were based on this data.

Operations data for military flights were based on very limited information. Emission estimates were based on fuel usage data (5-3), but actual daily flight schedules are unpredictable and not publicized. For the four military airports in the Bay area, hourly operations were estimated to be 90 percent during daylight hours and 10 percent night flights.

General aviation operations, mostly private single-engine aircraft, are also difficult to predict. In this project, general aviation emissions were uniformly distributed over daylight hours for 28 smaller community airports, and extended to include some early morning and late evening flights at busier Hayward and Buchanan Fields. Hourly traffic counts on airport approach roads were used to check the diurnal patterns of general aviation.

Since military and general aviation together form only about 1 percent of the total organic inventory, the assumed hourly distributions are considered adequate for present purposes.

AREA SOURCES

Area sources constitute another major challenge for spatial resolution. Among the 107 activity classifications in the BAAPCD source inventory, 58 include some area source contributions. Some of these are listed in Table 5-2. The total area source tonnage is substantial (see Table 5-1), but the location of the individual small sources is by definition distributed in some fashion over the geographical region of interest. Various alternatives for spatial resolution might be

Table 5-2. Excerpts[a] from the cross-classification table used for spatial distribution of area source emissions.

Tabled values represent the percentage of the area source emissions (from a given source classification) to be distributed with the indicated Series 3[b] variable. Blanks are zeros.

Area Source Classification			Series 3 Categories							
No.	Description	tons[c]	1 Dwell. units	7 Agric. forest	9 Print. publish	11 Food prod.	12 Elec/opt. equip.	13 Fabr. metal	23 Retail serv.	24 Other serv.
18	Farming operations	-		100						
19	Food/agric. proc.	6.1				100				
29	Org. solv. storage	10.9					20	20	5	
31	Indus. coating, solv.	99.2			10		10	50	5	
35	Degreasers	42.4					10	60	20	10
36	Dry cleaning, perc.	13.9							100	
40	Printing	10.2			100					
87	Lawn mowers	5.5	100							

[a] The full cross-classification table has 58 area source classifications and 19 Series 3 variable categories. (Numbering is not serial.)

[b] ABAG Series 3 Projections of population, employment, etc.

[c] Area source organics emissions, tons/day, for a summer weekday. Other pollutants have different emission rates but use the same distribution percentages.

considered (5-4, 5-5). The simplest would be to distribute the area source component uniformly over land area. This technique might be acceptable for a fairly uniform residential or agricultural area, but the great diversity of the Bay Area (cities, water, mountains, industrial and residential areas, etc.) precludes this method. The next level of complexity would be to distribute area emissions proportional to population. This would be a great improvement, but some major flaws remain. Most census data concerns residential population only and would thus displace the many non-major point sources which operate in industrial and commercial areas. Also spatial detail may be limited by census tract size, especially in sparsely populated areas.

The method actually developed for spatial resolution of area sources requires a cross classification of source categories with employment and land use data. A table of coefficients was compiled to link 58 source activity classifications (those with area source components) with 19 known employment and land use categories from ABAG's "Series 3 Projections" (5-6). The process is described in detail in AQMP/Tech Memo 21 (5-7).

The Series 3 work covers population, housing, employment and land use in the Bay Area. For the nine counties around San Francisco Bay, the data are compiled for 440 subregional areas termed "zones," which are made up of one to approximately seven 1970 census tracts. Housing is recorded by dwelling unit, and population/employment by 23 categories. The information was derived from census data, local surveys, fertility and immigration statistics. A list of the Series 3 variables used to allocate area source emissions is provided in Table 5-3.

Table 5-3. Summary list of nineteen Series 3[a] variables used in cross-classification analysis (for spatial resolution of area source emissions).

Series 3 Variable Code	Variable Name	SIC[b] Classification	Description
P1	DWELL	(not applicable)	Dwelling units
P7	AGRI	1, 7-9	Agriculture, Forestry
P8	MIN	10, 13, 14	Mining, quarry, oil & gas extraction
P9	MFG1	27	Printing, publishing
P10	MFG2	26, 28, 29, 32, 33	Petrol., chem., paper, metal industries
P11	MFG3	20	Food and kindred products
P12	MFG4	19, 36, 38	Electrical, optical, machinery & instr.
P13	MFG5	34, 35, 37	Fabricated metal products
P14	MFG6	22-25, 31, 39	Textiles, apparel, wood, leather
P15	TRAN	40, 42, 44-46	Transportation (non-auto), pipelines
P16	WHOL	50, 52	Wholesale trade, building material
P17	FIN	62, 63, 67	Financial, insurance
P18	SERV 1	73	Business services
P19	SERV 2	82, 84, 89	Educ. service, museums, galleries
P20	GOV	91, 92	Government
P21	RET	53-59	General merchandise & food stores
P22	BUS. SERV.	80, 81, 96	Health, legal, admin. services
P23	RET. SERV.	70, 72, 75-79	Hotels, personal service, repairs
P24	OTHER SERV.	15-17, 41, 47-49, 60,	Construction, transit, utilities, banking
	"	61, 66, 93-95, 99	real estate, other

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[a] ABAG Series 3 Projections of population employment, etc.

[b] Standard Industrial Classification Manual 1972.

Before it could be used as a basis for area source distribution, the Series 3 data had to be distributed over the 1-km UTM grid system. This critical step was accomplished by a combination of manual and computer techniques. First, regional maps were used to eliminate those grid squares which are essentially uninhabited. Those areas (bays, tidelands, marshes, mountains, etc.) comprise about 75 percent of the total area. Series 3 variables were then distributed from 440 zones to the remaining grid squares, which total 5000 to 6000 sq. km of developed or developable land. The exact total depends on the year being considered.

A cross-classification table was then developed to link certain types of area sources with appropriate Series 3 variables. For some source classifications a direct correspondence could be found. For example, BAAPCD source category number 18 "Farming Operations" could be linked with Series 3 employment category P7 "AGRI" which includes agricultural production and services. Similarly, source classification number 40 "Printing" could be distributed with Series 3 "MFG1" which is printing, publishing and related industries. In most cases, however, the source classification did not fit clearly with a single Series 3 variable. For these cases, professional judgment was employed to produce a multiple distribution formula, so that area source emissions from a single source classification could be distributed with two or more Series 3 variables. For example, source classification number 35 "Degreasers" provides area emissions of 42 tons/day of organics. These were distributed as follows: 60 percent with MFG5 (fabricated metal products), 20 percent with RET, SERV. (retail and services including auto repairs), 10 percent with MFG4 (manufacturing including electrical and optical equipment), and 10 percent with OTHER SERV. (including local transit and transportation services). Excerpts from the classification table are shown as Table 5-2. The percentage values were chosen by BAAPCD engineers, based on their knowledge of local industry conditions.

Area source emissions were distributed and then totaled for each Series 3 category (for each pollutant). Totals were divided by the known total population of the category to produce a per capita emission rate. As an example, for the 394 tons/day of organics for area source distribution (see Table 5-1), the total for Series 3 category P9, from all source classifications, was 20.75 tons/day. The total employment population in P9 (printing and publishing) was 25,170, so the per capita emission factor was .00082 tons/day of organics per printing/publishing employee. The per capita emission rates, for each Series 3 category and each pollutant, were then used with the known Series 3 population distributions to produce the area source spatial resolution. Results were checked by summing area source emissions over all grid squares. The totals must agree with total area source emissions (Table 5-1) used as a starting point.

It should be noted that changes in the percentage values shown in Table 5-2 do not change the amount of area source emissions (as long as the entries sum across to 100 percent). Only the distribution of the emissions would be changed.

The hourly distribution of area sources is based on diurnal variation coefficients for each source classification. These coefficients were compiled by engineers in the BAAPCD source inventory group. Weighted hourly variation factors were produced by multiplying area emissions per classification by the diurnal variation factors of each classification. The resulting (normalized) set of factors were then used for temporal resolution of all area source emissions.

MOTOR VEHICLES

The calculation of motor vehicle emissions is logically divided into two separate parts. The first part deals with emissions which occur on major streets and highways from vehicle engines that are fully "warmed-up" (i.e., hot stabilized). The second part covers emissions which occur primarily at the beginning and end of each trip due to different engine operating characteristics. These emissions are referred to as cold start, hot start, and hot soak. The data required to compute each of these two aspects of motor vehicle emissions are quite different, as are their resulting geographic and hourly distributions.

The highway- or "link"-related hot stabilized emissions were computed using modified versions of two computer codes previously developed for the Federal Highway Administration (5-8). The trip-end related emissions were computed through the use of programs developed at ABAG (5-9). The overall sequence of operation and input data requirements and sources for both codes are summarized in Figure 5-1. As shown, each set of programs outputs emissions on an hourly basis, geographically distributed by one kilometer UTM grid squares. The two data sets are then merged for input to the air quality model (LIRAQ). For input, both codes require transportation data from the Metropolitan Transportation Commission (MTC) and emission factors from the California Air Resources Board. A summary of baseline transportation data inputs is shown in Table 5-4.

TABLE 5-4. SUMMARY OF BASELINE TRANSPORTATION DATA INPUTS TO MOTOR VEHICLE EMISSIONS ESTIMATION

PARAMETER	YEAR			
	1965	1975	1985	2000[1]
VEHICLE TRIPS				
o Homebased work	1,706,983	2,144,693	2,542,951	3,038,406
o Non-work	5,370,480	6,904,098	8,215,373	9,859,449
o LDV Total	7,077,463	9,048,791	10,758,324	12,897,855
VEHICLE MILES				
o Homebased work	14,055,453	20,199,644	23,645,050	30,309,087
o Non-work	27,873,495	40,623,164	52,516,997	73,350,341
o LDV sub-total	41,928,948	60,822,808	76,162,047	103,659,428
o HDV @ 12.8 %	5,366,905	7,785,319	9,748,742	13,268,407
o Total VMT	47,295,853	68,608,127	85,910,789	116,927,835

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[1] Provisional Series III Base Case 1 Alternative

The motor vehicle emission factors used were derived through the use of a California Air Resources Board emission factor program, EMFAC3. This program was, in turn, based on EPA's Supplement 5* to AP-42, with some minor modifications.

The EMFAC3 program computed composite emission factors for HC and NO_x in units of grams per mile. It provided emission factor estimates for average route speeds from 5 to 50 mph, ambient temperatures from 20 to 80^0 F, and any desired mix of cold and hot start operation. Factors could be for a weighted average of four vehicle types (light duty auto, light duty truck, heavy duty gasoline, heavy duty diesel) or for each vehicle type.

ARB's EMFAC3 was the basis for computing the AQMP mobile source emission factors.** However, a number of variables, which vary with geographical location and estimation situation, can affect emissions estimates considerably: average vehicle speed, ambient temperature, type of vehicle, percentages of cold and hot start trips and percent of travel by vehicle age (see Figure 5-2). Therefore, localized correction factors reflecting these variables were developed based on Bay Area conditions.

Speed and ambient temperature correction factors were developed from formulas provided in EPA's Supplement 5 to AP-42. Estimates of

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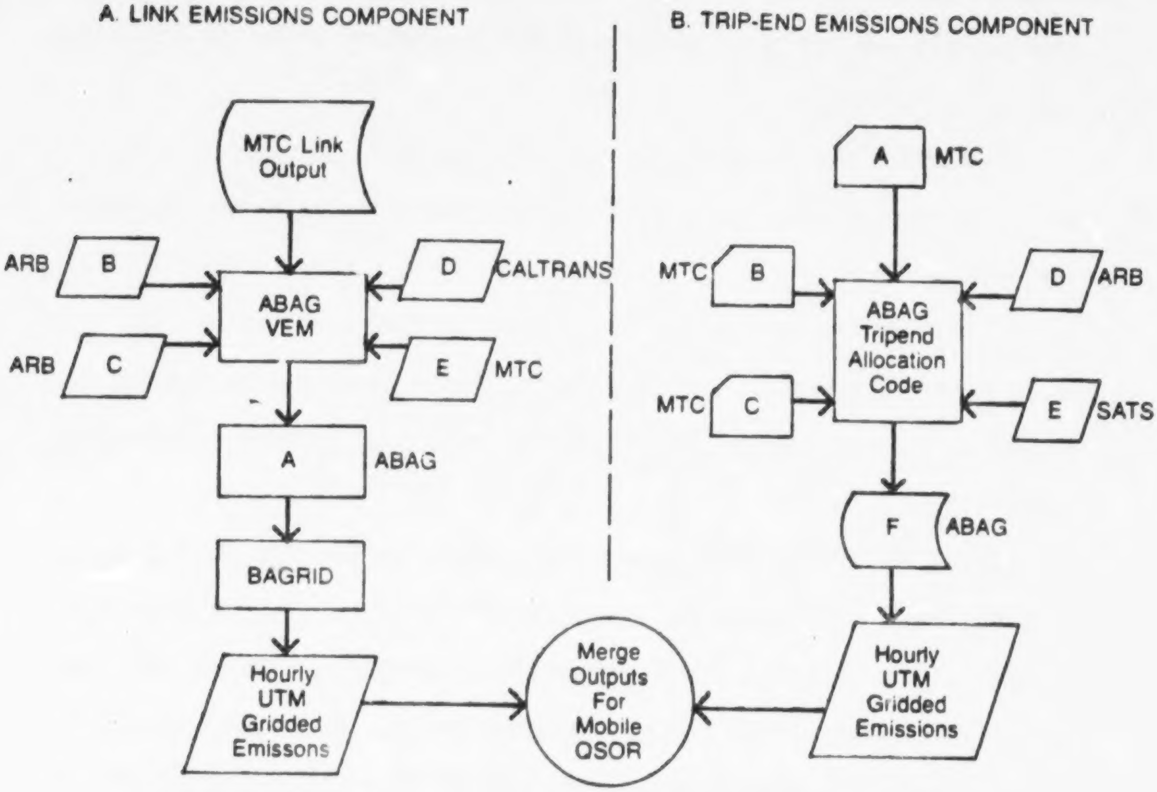
*This supplement has been replaced by Mobile Source Emission Factors, EPA-400/9-78-005, March, 1978.

**These factors were subsequently adjusted to incorporate EPA's draft Supplement 8 factors (June 1977). The latest revision to the Supplement (March 1978) was not available in time to be used in the analysis.

Figure 5-2

Organization of the motor vehicle emissions code


A. LINK EMISSIONS COMPONENT
B. TRIP-END EMISSIONS COMPONENT
MTC Link Output
ARB
B
ARB
C
D
CALTRANS
E
MTC
ABAG VEM
A
ABAG
BAGRID
Hourly UTM Gridded Emissons
Merge Outputs For Mobile QSOR
A
MTC
MTC
B
MTC
C
ABAG Tripend Allocation Code
D
ARB
E
SATS
F
ABAG
Hourly UTM Gridded Emissions

LINK EMISSIONS

Required input data:

A — State plane/UTM transform

B — Emission and deterioration factors for each model year for 1975, 1985, 2000

C — Motorcycle emission factors, SO_2 and particulate emission factors for all vehicles, weighted average for 1975, 1985, 2000.

D — Updated speed correction equations for LDV, HDV, diesel.

E — Percentage truck and motorcycle VMT by hour and functional road type

TRIP-END EMISSIONS

Required input data:

A — Origin-destination trip tables for each travel model run (including intrazonal)

B — Hourly distribution of trip starts by trip purpose for four soak periods

C — Intrazonal VMT per zone

D — Cold start, hot soak emission factors for 1975, 1985, 2000 (weighted average over vehicle population)

E — Hot-soak period distribution

F — 440 zone/1 km grid conversion

ABAG = Association of Bay Area Governments
ABAGVEM = name of computer code with vehicle emission factors
ARB = California Air Resources Board
BAGRID = computer code to distribute link emissions to grid squares
CALTRANS = California Department of Transportation
LIRAQ = Livermore Air Quality Model
MTC = Metropolitan Transportation Commission
QSOR = name of source inventory file for LIRAQ model
SATS = Sacramento Area Transportation Study
UTM = Universal Transverse Mercator coordinate system

link speeds and the distribution of vehicle types were provided by the Federal Highway Administration (FHWA). Assumptions for the average ambient temperature were a compromise between the average summer minimums and the maximums observed at different regional locations. The ambient temperature correction factor was insensitive to temperatures above 80° F. Vehicle age distributions and pollution control equipment deterioration rates (provided by EMFAC3) were also incorporated into the emission factors.

Link Emissions

A highway link system (for 1975 and updated for 1985 and 2000) and a transportation model to forecast travel volumes on each link were the basis for the link emissions calculations. Both the link systems and the transportation model were provided by MTC (see Chapter 3 for description). As previously stated, a modified version of FHWA computer code, called SAPOLLUT, was used to actually compute the link emissions, given the appropriate link information and the emission factors (5-8). The modified model, called ABAGVEM, computed estimates of speed on the highway network according to the volume/capacity ratio on each link, for each hour. These speed estimates determined the appropriate speed correction factor to apply.

ABAGVEM also provided diurnal traffic distributions and the distribution of vehicle types on different road types. Five types of vehicles were examined: light duty auto (LDA), light duty truck (LDT), heavy duty gasoline-powered vehicle (HDG), heavy duty diesel-powered vehicle (HDD) and motorcycle. The distribution of total VMT among the various vehicle types was obtained from ARB as follows:

Vehicle Type	Percent of Light Duty Vehicle VMT (LDA + LDT)
LDA	86.2%
LDT	13.8%
HDG	8.6%
HDD	4.2%
Motorcycle	0.9%

Finally, a separate program read the output from ABAGVEM (i.e., the hourly and total daily link emissions for the entire network) and performed the following:

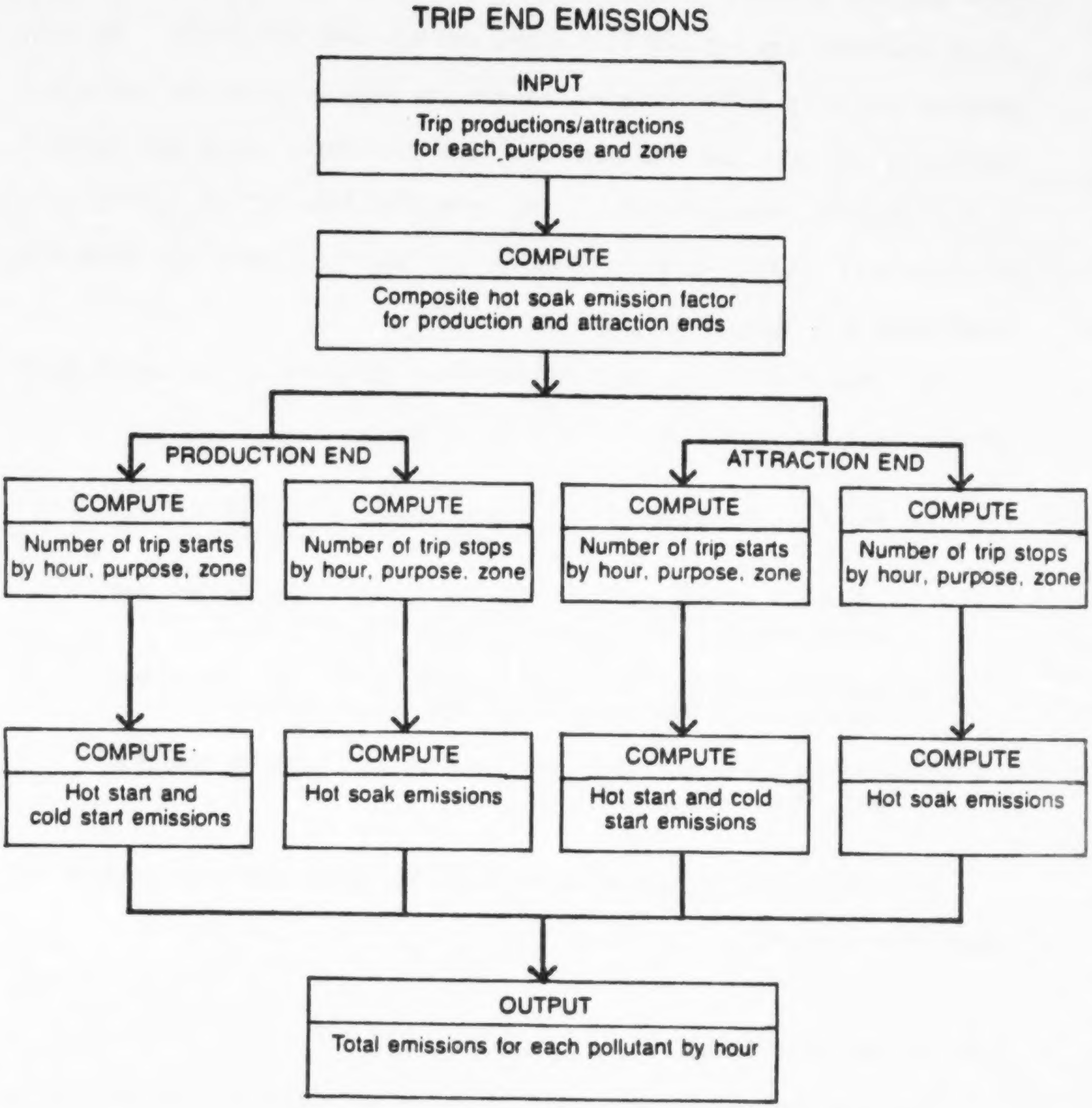
- converted the State plan coordinates of the MTC network to the UTM (Universal Transverse Mercator) coordinates required for LIRAQ.
- allocated the link emissions into three LIRAQ-defined reactivity classes
- wrote an output file in a format suitable for input to LIRAQ

Trip End Emissions

A separate computer program for estimating trip end emissions produced hot start, cold start and hot soak emissions by zone and hour of day (see Figure 5-3). It also computed hot stabilized emissions for intrazonal (i.e., within the zone) trips. The basis for the emissions computations was a trip generation table which was developed by the MTC transportation model. From this table the program computed the number of trip starts (i.e., origins) and stops (i.e., destinations). The emissions rates were determined as a function of the parking (or shutdown) time before and after a trip (for the start and stop trips, respectively) and whether the vehicle was catalyst or non-catalyst equipped.

Figure 5-3

Flowchart of trip-end emissions program.


TRIP END EMISSIONS
INPUT
Trip productions/attractions for each purpose and zone
COMPUTE
Composite hot soak emission factor for production and attraction ends
PRODUCTION END
ATTRACTION END
COMPUTE
Number of trip starts by hour, purpose, zone
COMPUTE
Number of trip stops by hour, purpose, zone
COMPUTE
Number of trip starts by hour, purpose, zone
COMPUTE
Number of trip stops by hour, purpose, zone
COMPUTE
Hot start and cold start emissions
COMPUTE
Hot soak emissions
COMPUTE
Hot start and cold start emissions
COMPUTE
Hot soak emissions
OUTPUT
Total emissions for each pollutant by hour

A special study by Caltrans provided parking time profiles by trip purpose and by trip end (origin or destination). From these profiles more accurate estimates were made of the percent of trip starts and stops experiencing hot and cold start and hot soak emissions. The trip purpose generally differentiated between the work related and therefore long-term parkers and the non-work, and therefore, short-term parkers (e.g., shopping, recreational). The trip end identified whether the vehicle was starting or stopping at the home zone and thus the likelihood of a long parking period.

In computing trip end emissions, four trip end types were considered. The work trip is cited as an example:

- the trip origins at the home (i.e., production) end, where many cold starts take place in the morning
- the trip destinations at the work (i.e., attraction) end, where many hot soaks take place in the morning
- the trip origins at the work (attraction) end, where many evening cold starts occur for the return trip
- the evening destinations back at the home (production) end, where hot soaks occur.

Note that the terms starts and origins, stops and destinations are used interchangeably.

BASELINE EMISSION TRENDS

The baseline trends for hydrocarbon and Nitrogen Oxides emissions are shown in Table 5-5 and shown geographically in Figures 5-4 and 5-5, respectively. For hydrocarbons, the most significant source categories were organic compounds evaporation (otherwise known as organic solvents) and both light and heavy duty motor vehicles. Each of these source

TABLE 5-5. EMISSIONS BY MAJOR SOURCE CATEGORY (TONS/DAY)

MAJOR SOURCE CATEGORY	1975		1985		2000	
	HC	NO_x	HC	NO_x	HC	NO_x
Petroleum Refining	25.2	5.9	41.0	15.2	55.4	20.0
Chemical	5.5	3.1	5.6	2.9	6.	3.9
Other Industrial/Commercial	10.2	2.5	11.1	2.7	12.7	3.1
Petroleum Refinery Evaporation	46.0	-	50.0	-	52.1	-
Gasoline Distribution	60.4	-	27.1	-	28.2	-
Other Organic Compounds Evaporation (Organic Solvents)	311.1	-	344.8	-	493.4	-
Combustion of Fuels	8.1	196.0	11.5	321.1	15.0	279.8
Burning of Materials	19.8	1.4	22.2	1.5	23.6	1.7
Off-Highway Mobile Sources	45.0	59.4	50.3	73.7	75.4	94.1
Aircraft	19.6	13.5	20.2	19.6	27.8	32.7
Light-duty Automobiles	340.1	231.7	117	89.3	160.6	77.1
Other Motor Vehicles	132.2	167.8	96	165.8	107.1	208.4
TOTAL (TON/DAY)	1,023	731	797	692	1,058	721

Figure 5-4

HYDROCARBON EMISSION TRENDS

SAN FRANCISCO BAY REGION

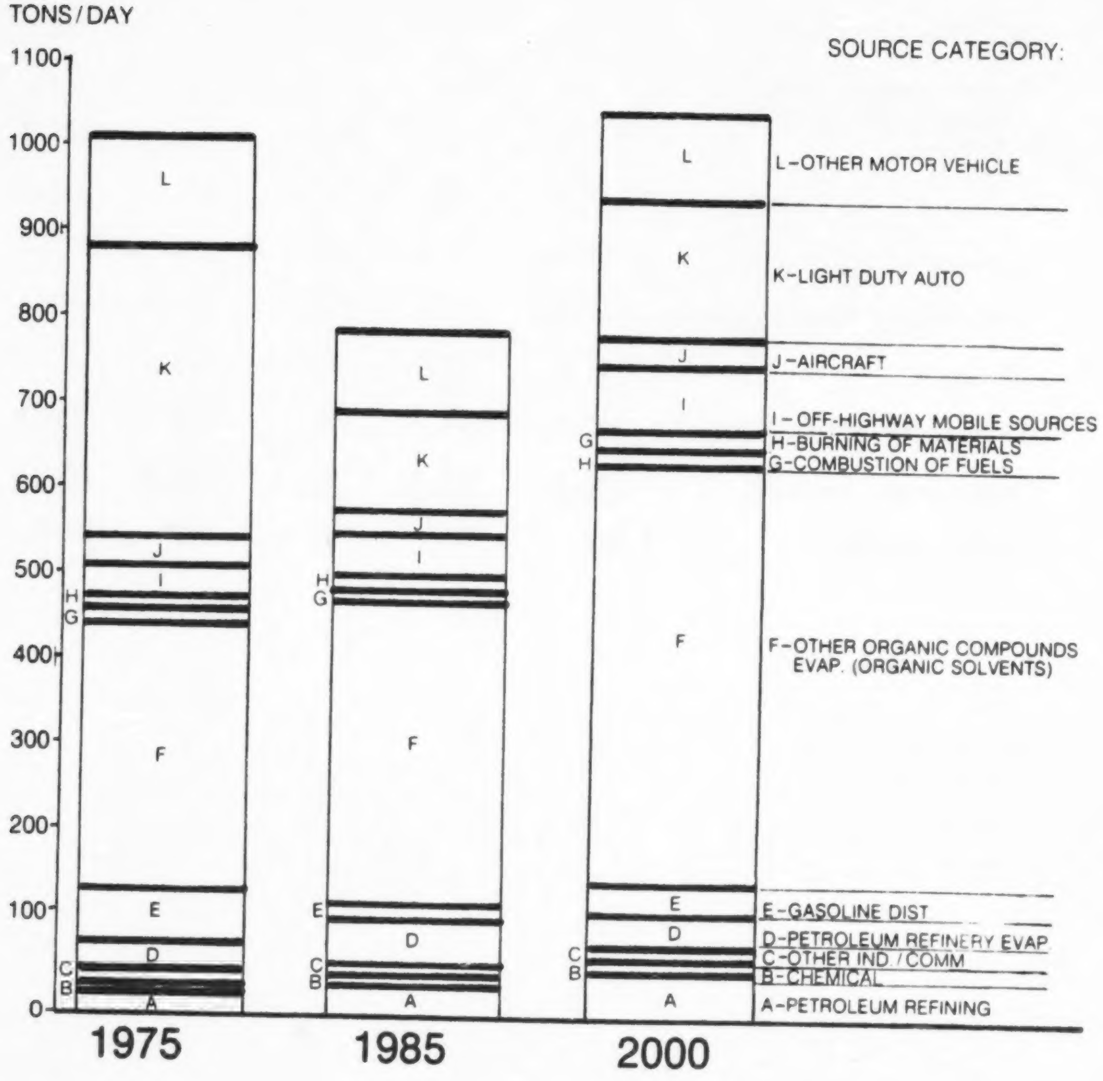
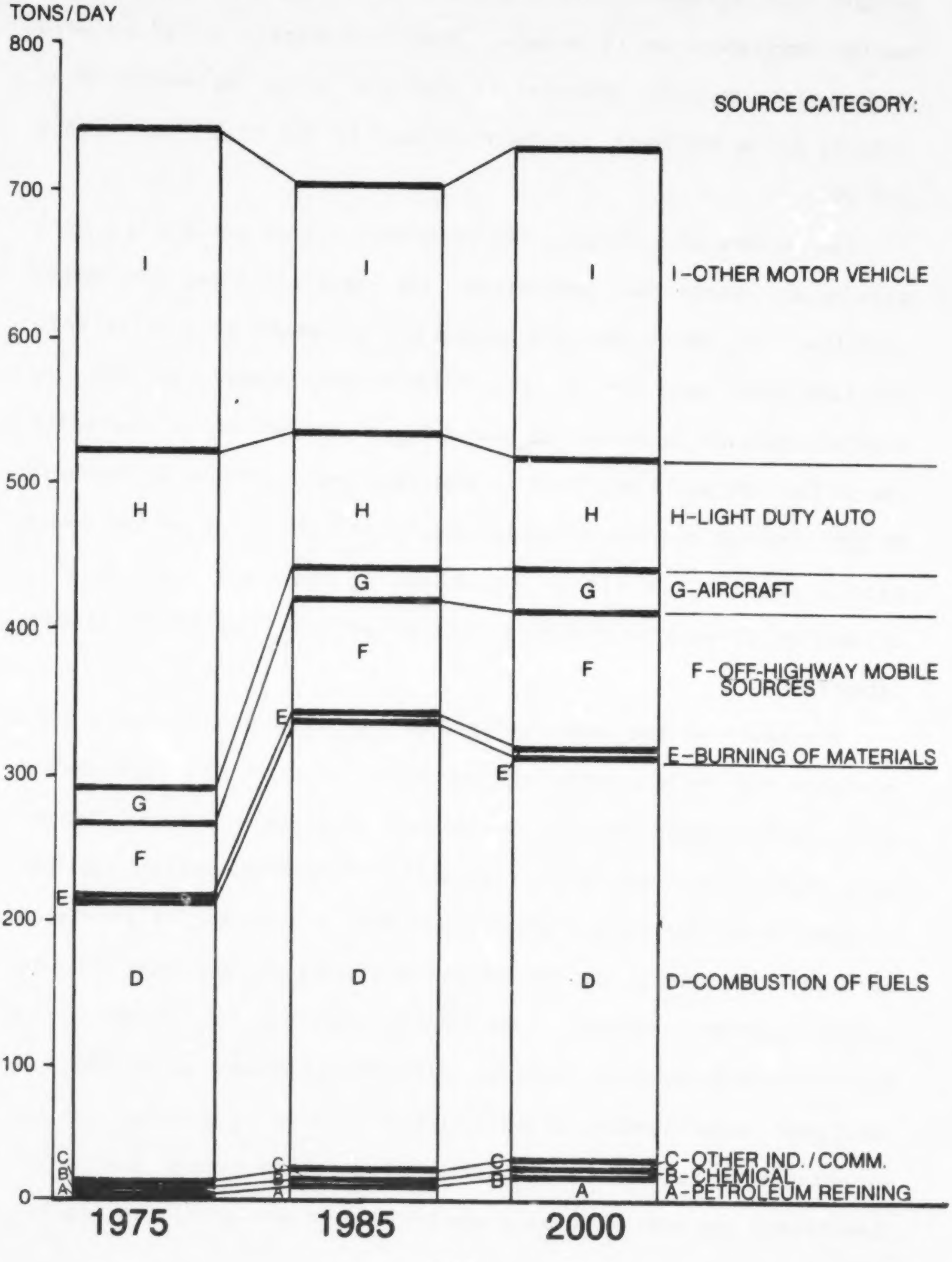


Figure 5-5

NITROGEN OXIDES EMISSION TRENDS

SAN FRANCISCO BAY REGION



categories had previously been the target of control efforts, and it was evident that further controls would be necessary if significant air quality improvement was to be made. Total hydrocarbon emissions were projected to decrease somewhat by 1985 due to the implementation of controls now on the books, but to rise back to the 1975 level by the year 2000.

For oxides of nitrogen, the principal source categories were stationary source fuel combustion, and light and heavy duty motor vehicles. NO_x emissions were projected to remain at a relatively constant level over the 25 year planning time frame. By 1985, the expected increase in stationary source NO_x emissions due to increased use of fuel oil would be offset by additional motor vehicle NO_x control. By 2000, increasing usage of nuclear fuels and/or siting of new power plants outside the region for electric power was assumed; this assumption offsets increases in NO_x emissions from other source categories.

A summary of the motor vehicle emissions, shown in Table 5-6, revealed that while automobiles contributed the majority of hydrocarbon emissions from motor vehicles, heavy duty gasoline and diesel trucks were significant contributors as well. Another observation was that emission levels for the pollutants would decline substantially between 1975 and 1985 due to the implementation of current legislated emission control programs. However, from 1985 to 2000 the overall growth in vehicular activity would begin to negate the gains made up to 1985. An additional factor leading to the long-term increase in emissions was the expected high rate of deterioration of emission control devices for conventional engines. EPA has projected that future autos meeting the

TABLE 5-6

SUMMARY OF BASELINE MOTOR VEHICLE EMISSION PROJECTIONS* (TONS/DAY)

HYDROCARBONS	1975	1985	2000
Tripend	206.0	99.0	127.7
Link	266.3	113.9	140.0
Total	472.3	212.9	267.7

OXIDES OF NITROGEN	1975	1985	2000
Tripend	17.6	16.0	13.6
Link	381.8	239.1	271.9
Total	399.4	255.1	285.5

APPROXIMATE PERCENT OF EMISSIONS FROM EACH VEHICLE

VEHICLE CLASS	1975		1985		2000	
	HC	NO_x	HC	NO_x	HC	NO_x
Light duty autos	72%	58%	55%	35%	60%	27%
Light duty trucks and motorcycles	8%	9%	8%	6%	6%	7%
Heavy duty gas trucks	19%	17%	33%	28%	28%	30%
Heavy duty diesel	1%	17%	5%	30%	5%	36%

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* Revised in July, 1977 according to a June, 1977 memo issued by the Acting Assistant Administrator for Air and Waste Management, U.S. Environmental Protection Agency regarding the revised Motor Vehicle Emission Factors, and a July, 1977 memo issued by ARB to local AQMP agencies regarding the incorporation of the revised motor vehicle emission factors into the AQMP phase II effort.

stringent emission standards when new would not maintain the high degree of control for very long.

Another significant aspect of the motor vehicle emissions trends was the contribution of trip-end versus link (or VMT) related emissions. When a vehicle with a cold engine is started up, the emission rate during the first few minutes of driving is considerably higher than after the engine temperature has stabilized. A short trip produces the same amount of cold start emissions as a long trip, the only difference being the quantity produced after the engine has warmed up. It was clear that transportation control strategies had to not only reduce VMT but to reduce the number of trips.

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Chapter 6

PROJECTING AIR QUALITY

The Bay Area oxidant problem is characterized by complex atmospheric, chemical and topographical interactions. Pollutants already in the air (initial concentrations) and those added to the air (source emissions) are transformed into the resulting air quality (atmospheric pollutant concentrations) through the processes of atmospheric transport, mixing, chemistry and photochemistry. Each of these processes usually will have large spatial and temporal variations caused by topography, diurnal solar cycle, the mix of pollutants, etc. Previous planning efforts to improve air quality in the Bay Area have been hindered because the air quality forecasting methods did not take into account all of these factors and were not technically credible or defensible. In 1975, the Lawrence Livermore Laboratory* completed the development of an air pollution model specifically designed to address the oxidant problems of the Bay Area. LIRAQ (Livermore Regional Air Quality Model) focused on an accurate simulation of chemical reactions, pollutant transport, varying meteorology and base inversion heights to produce detailed pollutant concentrations levels. An inventory of all existing air quality forecasting methods revealed that LIRAQ was eminently suited for the task of evaluating effectiveness of control measures. Thus, LIRAQ formed the technical basis for developing the oxidant control plan.

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*In cooperation with the BAAPCD.

In order to properly determine whether controls would satisfy air quality standards, LIRAQ required a wide variety of source emissions data on an hourly basis for each grid square covering the region. These stringent data requirements resulted in the development of a complex battery of models from numerous sources, which combined to comprise the AQMP air quality modeling system.

The AQMP air quality modeling system had six components:

- Population, employment, housing and land use models maintained by ABAG (the ABAG Series 3 Projections System);
- Travel demand forecasting models maintained by MTC;
- The Emission Inventory and Disaggregation Models--Motor Vehicle (ABAG), Aircraft (BAAPCD), Stationary Source (BAAPCD);
- LIRAQ maintained by the BAAPCD.

The demographic, travel demand and emissions inventory and disaggregation models have been described in Chapter 3. The following sections discuss how LIRAQ was used to project future air quality and to help develop the appropriate control strategies.

THE LIVERMORE REGIONAL AIR QUALITY MODEL

Independent of the AQMP, LIRAQ was developed as an operational tool to assist in determining whether control strategies complied with Federal ambient air quality standards. Specifically, given the emissions patterns and meteorological process, LIRAQ would provide hourly concentrations of ozone for the Bay Area.

An inventory of air quality models was made at the outset of the study to determine how control strategies would be evaluated. A major shortcoming of previous air quality plans for the Bay Area and other regions had been the use of an aggregated emission inventory and the "linear rollback" technique. This approach to predicting future air quality was based on past meteorological and air quality trends. The shortcomings of linear rollback (and modified versions*) were as follows:

- Linear rollback related oxidant to hydrocarbons only; it is known that oxidant levels depend significantly on both reactive hydrocarbons and NOx emissions.
- Linear rollback neglected important non-linearities in the oxidant-hydrocarbon relation.
- Linear rollback neglected background oxidant levels that may have been significant.
- Linear rollback neglected the spatial distribution of emissions and the issue of transport.

The advantages of the linear rollback were two-fold:

- The relationships were based on actual atmospheric data (if available) and would predict successfully even when the actual physical process (of oxidant formation) was not understood completely.
- It was simple and relatively inexpensive to apply.

The recommended modeling approach was therefore to:

1) Achieve technical validity through use of LIRAQ - The modeling approach should represent the state of the art in air quality modeling and thus establish the technical credibility of the analysis.

2) Achieve technical consistency through the use of the statistical Larsen analysis combined with the linear rollback assumption. Due to the more simplistic assumptions underlying the statistical approach, the results were easier to interpret and more consistent.

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*e.g., the method presented in Appendix J of the EPA's regulations governing development of State implementation plans (40 C.F.R. part 51.14(c)(4) (1975)); Appendix J was revoked February 8, 1979 (40 FR 8234).

The application of two radically different approaches would define a range of future air quality from a given strategy. This range would reflect the technical uncertainties that exist in air quality modeling.

PROJECTING AIR QUALITY -- MODELING ISSUES

In developing the modeling procedures, certain issues had to be resolved in order to achieve data consistency and validity. These issues were: which prototype meteorological days to use, how to validate the model and what future initial and boundary conditions to specify.

Baseline Projections--Baseline air quality levels were developed for 1975 for calibration purposes and for 1985 and 2000, for emissions sensitivity testing. These levels assumed no additional controls and existing regional growth trends. An important aspect of the baseline and subsequent projections was the choice of a "prototype meteorological day" for validating and running LIRAQ. As a deterministic model, LIRAQ was designed to replicate the physical processes of oxidant formation in the course of one day based on real, previously acquired meteorological observations. In part for economic reason, "prototype meteorological days" already in the LIRAQ data base at the beginning of the study were used in prediction of future oxidant concentrations; however, they were not the worst case days. Since the oxidant standard was defined as "not to be exceeded more than once per year," demonstrating oxidant levels at or below .08 ppm on days which were not the worst or second worst day did not necessarily demonstrate the attainment of the standard. However, LIRAQ had already been validated on several historical days in order to verify that it could produce the oxidant levels that were measured on those days. Inputs of each prototype day required several months of effort to develop because the data collection and computer processing tasks were labor intensive.

A correction factor based on observed and Larsen Model calculations was therefore applied to the LIRAQ estimate to obtain the expected worst-hour oxidant.

The Model Validation Process--Since models invariably contained simplifications and modifications of what happened in reality, it was expected that model predictions would not replicate perfectly the observed measurements. A procedure was therefore devised for computing adjustment factors to LIRAQ output as follows:

$$\frac{C_f}{C_v} = \frac{C_s}{C_m} \quad \text{or} \quad C_s = \frac{C_m}{C_v} \cdot C_f$$

Where C_m = regionwide high hour oxidant concentration measured on the validation day

C_v = regionwide high hour oxidant concentration reproduced by the model on the validation day

C_f = regionwide high hour oxidant concentration forecasted by the model under some future emission scenario

C_s = regionwide high hour oxidant concentration to be computed and compared to the oxidant standard

In other words, the ratio of the measured regionwide high hour oxidant concentration on a given validation day to the model-produced regionwide high hour oxidant concentration was used to adjust forecasted oxidant maxima. This compensated for any inherent biases in the model or input data. For example, on July 26, 1973, the measured oxidant maximum was .18 ppm, while the model-produced maximum was .17 ppm. The adjustment ratio was therefore .18/.17 = 1.06.

This procedure was reasonable provided that the magnitude of the adjustment was small. No adjustment factor could be expected to adequately compensate for major deficiencies in either model formulation or input data base. The small magnitude of the adjustment for July 26, 1973 was indicative of good model performance.

Specifying Future Initial and Boundary Conditions - The specification of initial and boundary conditions for future year simulations was an important problem for oxidant modeling, particularly when testing control strategy cases which would reduce the simulated oxidant levels to levels at or near the oxidant standard. As emissions were reduced, the contribution of pollutants specified to enter the grid from its boundaries (boundary conditions) became increasingly important. Concentrations of pollutants at the boundaries of a metropolitan area were poorly understood. There were very limited data which could be used for validation on a historical day, and virtually no data for future year simulations which could act as a guide.

These problems were dealt with in the plan development effort in the following way:

- Initial conditions for hydrocarbons and nitric oxide were factored up or down proportionally to the change in the aggregate regional emission inventory for each pollutant. In addition, all simulations were initiated in pre-dawn hours to minimize the initial concentrations of secondary pollutants.
- Since the prototype meteorology being used consisted of a prevailing onshore wind, flow through the upwind boundary was assumed to contain background levels of all species both during model validation and during future year simulations.

- The vertical boundary condition at the base of the temperature inversion was originally defined to depend partially on the concentration of pollutants in the grid cell below. Therefore, as emission levels changed, the boundary condition at the ceiling would change in the same direction. Since the degree of vertical transport down from the inversion was relatively small on the prototype day, no change in this form of specification was considered warranted.

The specification of the vertical boundary condition and the resolution of the worst case issue appeared to be intimately related. There was evidence that in California the highest oxidant levels were measured during multiple-day episodes which involved substantial transport of polluted air down from the inversion. This polluted air, believed to result from a previous day's events and sheltered from substantial NO_x quenching by the inversion, mixed with the "fresh" pollutants generated on the high oxidant day, producing the extreme concentrations recorded.

If one attempted to validate a model on such a worst case day, one would have been faced with the problem of specifying the crucial vertical boundary concentrations with little or no data to guide the specification. If one attempted to validate a model on a day where the boundary condition was not crucial, some sort of extrapolation would have to be made to relate the model results to the oxidant standard.

EMISSIONS SENSITIVITY TESTING

The time and monetary resources required to produce a single complete run of the air quality forecasting system was substantial--in excess of several thousand dollars for staff and computer costs. This resulted in two courses of action when developing the control strategies:

- extensive use of pre-screening techniques so that the control measures which were finally tested had the greatest potential for improving air quality.
- performing an emissions sensitivity analysis to determine the target emissions reductions of hydrocarbon and NO_x which would be required to attain the Federal oxidant standard. This target would be the basis for packaging the control measures into strategies for further testing.

The sensitivity analysis was implemented in successive iterations using a number of different hydrocarbon and NO_x emissions assumptions described below:

- uniform percentage reduction of both hydrocarbons and NO_x uniformly across the region until the oxidant standard was attained;
- uniform hydrocarbon reductions only until the standard was attained;
- other tests on the spatial and temporal distribution of emissions, mobile versus stationary source contributions, etc.

The analysis was applied to both the 1985 and 2000 emissions inventories in a systematic fashion such that results from previous runs could permit the optimum design of subsequent new runs. The results of the sensitivity runs are presented in Figures 6-1 through 6-3. Figure 6-1 shows the east-west traverse (AA') and north-south traverse (BB') along which map ozone has been plotted in Figures 6-2 and 6-3, respectively. It is seen that the 40% HC/20% NO_x curve exceeds the 40% HC curve at almost every point. Figure 6-4 plots the regionwide high hours versus percent reduction of hydrocarbon only emissions. It also shows how the LIRAQ output is adjusted according to the previously

Figure 6-1

BASELINE MAP AT 1500 PST FOR 1985 EMISSIONS AND JULY 26, 1973 METEOROLOGY, SHOWING EAST-WEST SECTION LINE AA′ AND NORTH-SOUTH SECTION LINE BB′

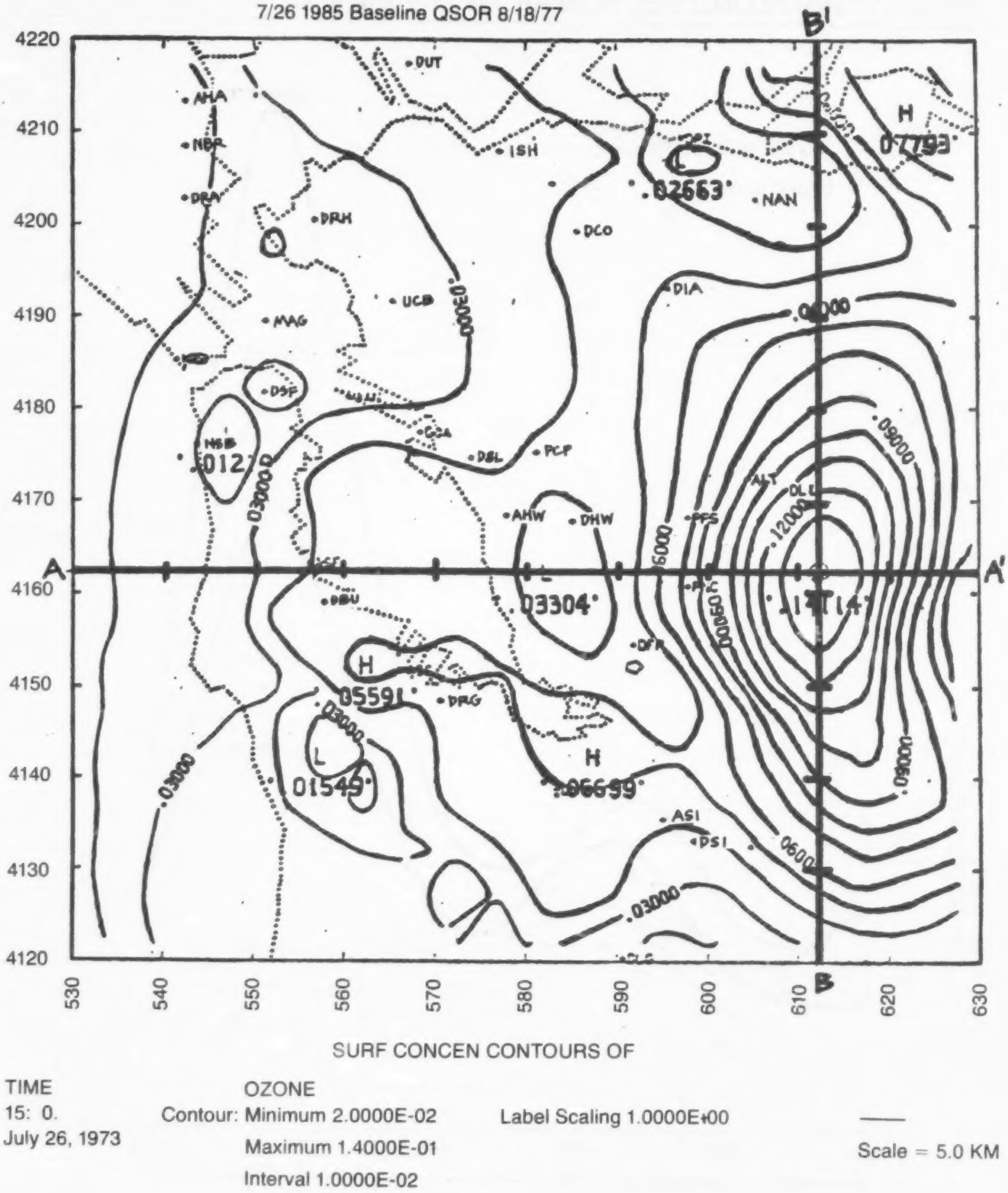

7/26 1985 Baseline QSOR 8/18/77
B′
B
A
A′
4220
4210
4200
4190
4180
4170
4160
4150
4140
4130
4120
530
540
550
560
570
580
590
600
610
620
630
DUT
AHA
NBR
DRA
DRH
ISH
DCO
NAN
DIA
UCB
MAG
DSF
NSB
CCA
DSL
PCP
AHW
DHW
PFS
ALT
DLL
DBU
DFP
DRG
ASI
DSI
DLC
H
.07793
L
.02663
.03000
.09000
.12000
.06000
.03000
.012
.03304
.14114
H
.05591
L
.01549
H
.06699
SURF CONCEN CONTOURS OF
TIME
15: 0.
July 26, 1973
OZONE
Contour: Minimum 2.0000E-02
Maximum 1.4000E-01
Interval 1.0000E-02
Label Scaling 1.0000E+00
Scale = 5.0 KM

Figure 6-2

EMISSION SENSITIVITY RESULTS COMPARED BY VARIOUS PERCENT REDUCTIONS ALONG SECTION AA′ OF FIGURE 6-1

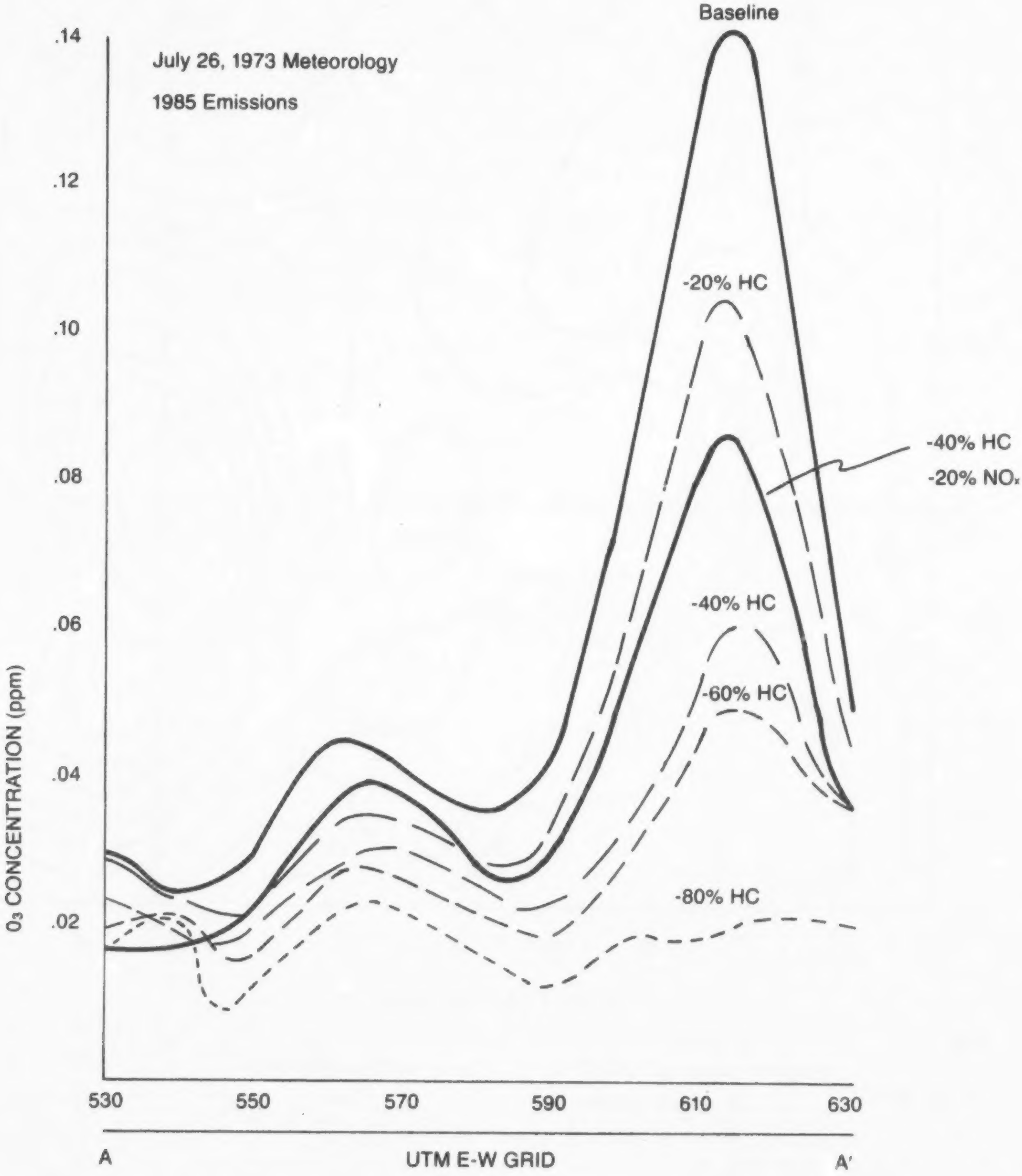


Figure 6-3

EMISSION SENSITIVITY RESULTS COMPARED BY VARIOUS PERCENT REDUCTIONS ALONG SECTION BB′ OF FIGURE 6-1

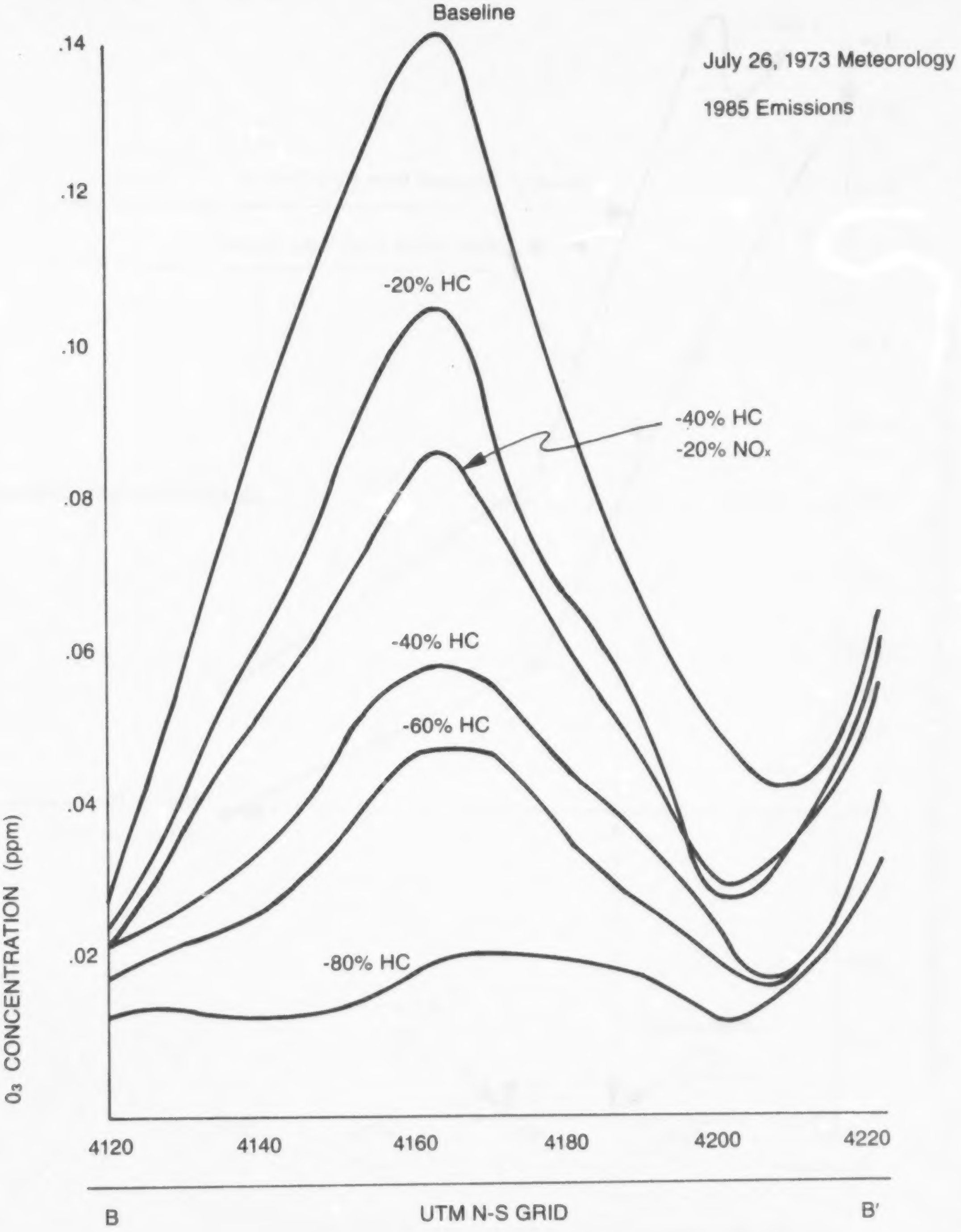
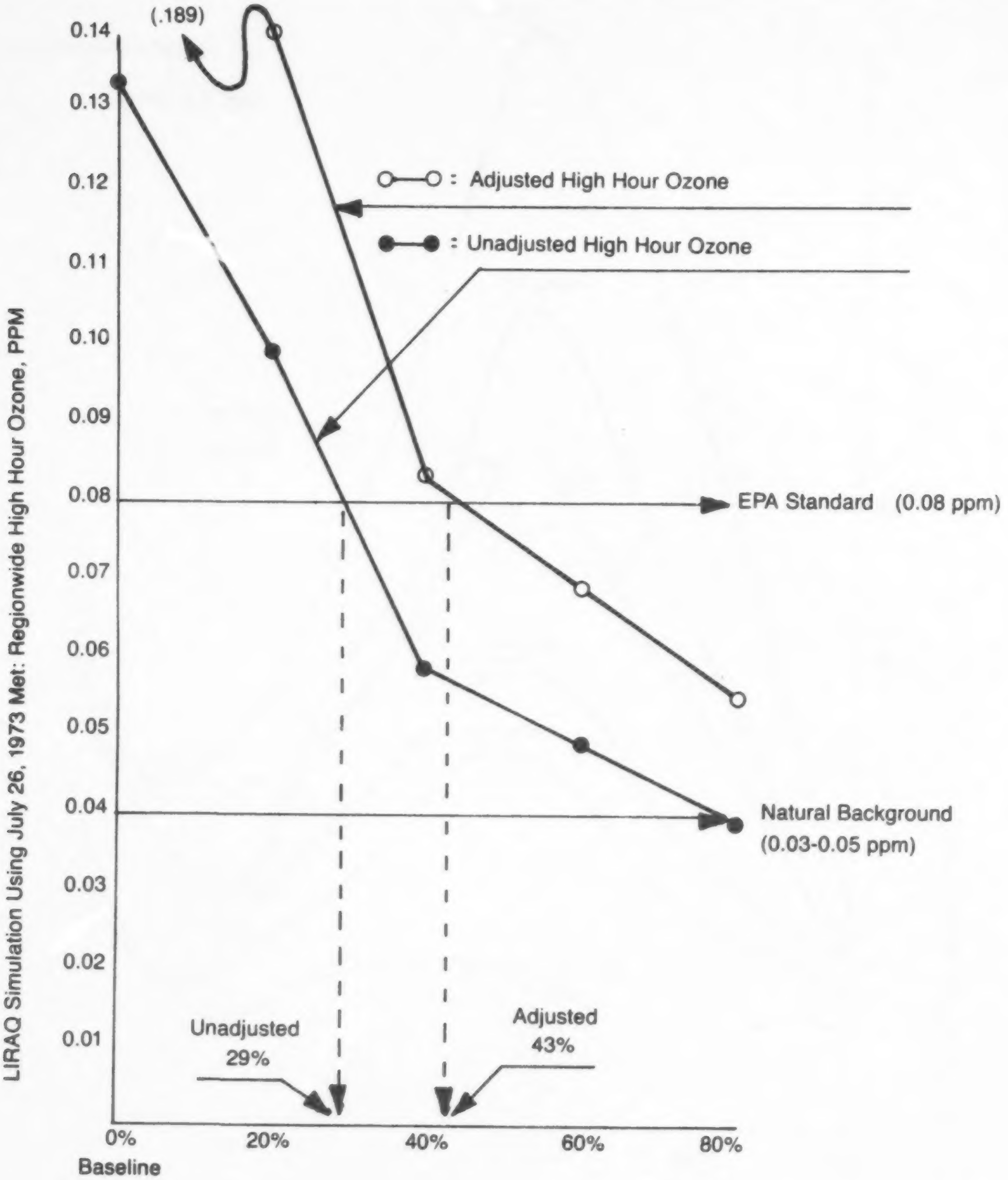


Figure 6-4

PLOTS OF UNADJUSTED AND ADJUSTED REGIONWIDE HIGH HOUR OZONE AS A FUNCTION OF % REDUCTIONS OF 1985 HC EMISSIONS



Percent Reduction of 1985 Baseline Hydrocarbon Emissions documented worst case and validation procedures.

The conclusions derived from these initial runs were:

- o A reduction of hydrocarbon emissions alone was more effective than the combined reduction of hydrocarbons and nitric oxide emissions;
- o Nitric oxide quenching was significant factor in oxidant control;
- o By extrapolating the 1985 result, a 56% reduction of hydrocarbons would attain the standard in 2000.

Chapter 7

DEVELOPMENT OF ALTERNATIVE CONTROLS

Air quality improvements can be achieved in many different ways. A first step to developing alternative control strategies is accurately documenting existing and planned programs. After assessing the impacts and effectiveness of ongoing and currently scheduled controls, an inventory can be made of additional measures which need to be considered. In some cases certain programs may be considered to be already in existence, e.g., transit service, vehicle exhaust emission standards. What is considered then is a further strengthening or expansion of the program in place, e.g., more transit service, lower vehicle exhaust emission standards.

EXISTING AND PLANNED PROGRAMS

Many control programs for air pollution currently exist in the San Francisco Bay Area. More are scheduled to be implemented in coming years. These programs are discussed according to program implementing authority and/or responsibility in the following paragraphs.

Stationary Source Emission Controls

In the San Francisco Bay region, the Bay Area Air Pollution Control District (BAAPCD) has been empowered to control air pollution from stationary sources. Since its formation in 1955, the District has developed air pollution control programs for many categories of stationary sources.

To date the BAAPCD has enacted ten regulations, and seven of these affect stationary sources. Some of them directly control air pollution by limiting the emissions of specific pollutants, either on a mass flow rate or concentration basis. Other regulations indirectly control pollutants by curtailing open burning, new source construction and expansion of existing stationary sources. Some sections deal specifically with emissions of odorous substances and others limit the density of smoke which may be emitted to the atmosphere. The regulations of the BAAPCD have been expanded and modified through the years, and are generally acknowledged to be among the most stringent in the United States. A summary of present BAAPCD's regulations on stationary source control for oxidants is given in Table 7-1. More detailed information can be obtained from the BAAPCD. Additionally, a number of Federal and State air pollution control regulations are also applicable to stationary sources control in the Bay area.

Motor Vehicle Emission Controls

The California Air Resources Board (CARB) is the State agency responsible for coordinating both State and Federal air pollution control programs in California. This responsibility includes regulation of pollutant emissions from motor vehicles and coordination of local programs for stationary source control.

Due to the severity of air pollution problems in California, the federal government gives the State the option of enforcing motor vehicle emission standards which are more stringent than federal emission standards. Thus, while the Envionmental Protection Agency takes primary responsibility for motor vehicle emissions control, the CARB can and has adopted and enforced emission standards more stringent than required at the Federal level. This section summarizes CARB responsibilities for mobile source control.

Table 7-1

Summary of Existing BAAPCD's Regulations on Stationary Source Control for Oxidants

Regulations	Controlled Source (or Process)
1.	Trash Burning and Dump Fires
2.	Service Stations, Industrial and Commercial Sources and New Sources (NO_x, SO_x, Odor, Lead, particulates)
3.	Formulation, Storage, Shipment and use of Solvents, Paint, Gasoline and Ink
5.	Definition of Air Pollution Episodes and Specific Actions
7.	New or modified sources including Fossil Fuel Power Plants, Larger Incinerators, Cement Plants, Acid Plants, Refineries, Smelters, and Steel Plants
9.	Emission control on various Architectural coatings
10.	Emission control on volatile organic compounds emissions from valves and flanges

The CARB currently has regulations which control emissions from light, medium, and heavy duty gasoline powered vehicles, diesel powered trucks and buses, and motorcycles. In addition, the CARB has in effect various regulations and procedures to ensure that emission standards are met. Current vehicle emission standards adopted by the CARB and recently enacted federal statues are presented in the AQMP for the Bay Area.

Transportation Controls

A number of transportation control projects are currently operating in the San Francisco Bay Area. Some were required as elements of the transportation control plan, while others are the result of regional transportation planning. These transportation controls are summarized in Table 7-2

The experience with transportation programs has been valuabe. The carpool incentives seem to be successful. The transit additions are also rather significant, but the problems of financing are becoming critical. Despite these incentives, auto travel has not really decreased. This would indicate that some combination of auto restraints and more transit/carpool incentives is needed.

Land Use Management/Development Controls

This term as traditionally used is a misnomer since measures dealing with land use, or land development, include a wide array of non-regulatory devices from the general plan of cities and counties to the service commitments of special districts. The more current and more widely used term "growth management" also means many different things in many different jurisdictions. Hence, in the ABAG Environmental Management Plan we use the terms "development policy" or "development

Table 7-2

Summary of Current Transportation Control Measures in the San Francisco Bay Area.

- Ramp and Mainline Metering to improve traffic flow - Meters are operating on segments of I-580, I-280, Rt. 101, Rt. 17 and Bay Bridge.
- Preferential Bus/Carpool Lanes on Freeways (Rt. 101, Rt. 280, Rt. 580) and on certain streets in San Francisco.
- Bridge Toll Incentives (Bay Bridge, San Mateo - Hayward and Dumbarton Bridges, and Golden Gate Bridge).
- Regionwide Carpool and Vanpool Matching Program.
- Improvement of Regional Transit Service.
- Preferential Parking for Carpooling Vehicles.

strategy" to signify the land development objective sought, and the term "policy instruments" to mean the measure or tools of implementation.

There are various land use management and development policies currently existing in the San Francisco Bay Area. They can be broadly grouped into three categories: Development supporting, development constraining, and neutral or mixed policies. Table 7-3 presents a list of land use development policies in effect in the Bay Area in 1975. Based on the number of jurisdictions using them, the following general conclusions are noted:

- Among development supporting instruments, assessment districts, redevelopment programs, and capital improvement programs for transportation, sewer, and water systems are the most common. Redevelopment incentives such as tax incentives or other special land reserves with service commitments are relatively rare but do exist as precedents for more widespread application in the region.
- Among development constraining instruments, open space zoning (and easements), public land acquisition, sewer connection limits and zoning moratoria are most prevalent; numerically transportation access limits, building permit moratoria, and prime agricultural land preserves are of secondary importance.
- In the category of instruments that can be used to constrain or support development, the Local Agency Formation Commission (LAFCO) spheres of influence dominate.

INVENTORY OF OPTIONS (OR CANDIDATE CONTROL MEASURES)

Because so many possibilities exist for consideration, the AQMP Joint Technical Staff and later the AQMP Advisory Committee were involved in screening the control options which are developed. The screening process led to a more manageable number of options which were evaluated further by the AQMP Joint Technical Staff.

Table 7-4 lists the inventory of air pollution control measures considered in developing the AQMP. The inventory is organized according to the participating agencies which prepared the component parts.

Table 7-3. Summary of Land Development Policies in Effect - Bay Region 1975

Land Development Policy Instruments (In rank order by frequency regionwide within group)	Number of Jurisdictions Using			
	Total Active	Prior to 1970	1970 to 1975	Expect by 1977
Group 1 Supporting Development				
Assessment (Improvement) Districts	34	30	4	1
Public Assisted Housing Programs	25	12	13	2
Redevelopment Programs	15	7	8	8
Transportation Extension C.I.P.	21	16	5	4
Sewer Extension Capital Improvement Program	14	10	4	5
Public Housing Programs	9	6	3	1
Water Extension Capital Improvement Program	8	8	0	1
Low Income Housing Program	8	3	5	6
Special Service Commitments	6	5	1	2
Sale of Public Land	6	5	1	0
Industrial/Commercial Land Reserve (other than zoning)	0	0	0	3
Group 2 Neutral or Mixed (used to support *or* constrain Development)				
City Spheres of Influence (by LAFCO)	39	12	27	0
Development Fees	37	27	10	1
User Charges	32	27	5	0
Cluster Zoning	28	21	7	3
Slope/Density Zoning	21	6	15	6
Plan Conformance Rezoning	19	1	18	14
Mass "Up" or "Down" Zoning	11	1	10	8
Development Rights-Purchase or Transfer	8	5	3	4
Land Banking	3	-	3	2
Development Sequence Zoning	4	4	0	4
"Floating Zones"	3	3	0	3
Group 3 Constraining Development				
Open Space Zoning	26	5	21	8
Open Space Easements	23	5	18	4
Zoning Moratorium	18	8	10	5
Sewer Connection Limits	20	9	11	3
Land Acquisition for Public Use	20	12	8	1
Prime Agricultural Land Preserves	11	5	6	1
Building Permit Moratorium	11	0	11	0
Watershed Protection Program	13	8	5	1
Transportation Access Limits	12	7	5	2
Water Connection Limits	7	4	3	3
Other Utility Connection Moratorium	7	7	0	0

Source: Preliminary tabulations ABAG Local Policy Survey, 8/15/76. 65 cities reported of 76 responding. Special districts not included.

Table 7-4. Inventory of Air Pollution Control Measures

I. Stationary Sources

1. Require the use of high solid coatings where practical.
2. Require the use of water based coatings where practical.
3. Adopt the CARB standards for organic liquid storage.
4. Adopt closed system organic liquid storage with vapor recovery.
5. Require vapor recovery on small solvent users.
6. Adopt organic solvent regulation developed by the CARB Organic Solids Committee.
7. Enact a new maximum SO_2 emission limit of 300 ppm.
8. Require reduced sulfur content in fuels to .025%.
9. Adopt NO_x controls for non-highway and construction equipment.
10. Adopt NO_x limits for all new boilers.
11. Adopt lower particulate loading requirement - 0.05 to 0.1 grains/SCFM.
12. Adopt lower process weight allowable scale.
13. Adopt lower process weight maximum allowable scale.
14. Adopt best available control technology (BACT) regulation for existing sources with a time scale for compliance.
15. Adopt BACT regulation for all sources in lieu of emission concentration limits.
16. Adopt BACT regulation for all sources in addition to emission concentration limits.
17. Adopt a modern process technology rule aimed at promoting modernization of the areawide plant. This might, for instance, suspend a BACT rule for an agreement to modernize a plant with BACT included in modernized version. The intent of such a regulation would be to encourage modernization of old plants with new plants having improved pollution control technology.
18. Extention of current BAAPCD requirements to smaller operations, i.e., fewer exemptions.
19. New Source Review (NSR) - continue present rule.
20. New Source Review - Adopt 100% off-set policy.
21. New Source Review - Adopt 110% off-set policy.
22. New Source Review - Adopt a sliding scale for emission off-set.
23. NSR Options 20, 21 or 22 with a limited area for emission off-set.
24. NSR Options 20, 21 or 22 with inter-pollutant emission off-set.
25. NSR Options 20, 21 or 22 with no inter-pollutant off-set or inter-pollutant off-set governed by location, etc.
26. NSR Options 20-25 qualified so that no credit is allowed for emissions that are in excess of other limitations.
27. NSR Options 20-25 with arrangement for off-set banking, allowing a prospective new source credit for emission reduction off-set achieved beyond that required by existing regulations.
28. Adopt regulations to promote industrial energy conservation.
29. Plant operation scheduling:
    - a) Seasonal scheduling to reduce polluting operations during critical weeks or months as determined by meteorology.
    - b) Scheduling maintenance down time and vacations, possibly short downs, to reduce pollutant load at critical times.
    - c) Interruptable operation dependent upon air quality conditions.
    - d) Stagger operations between plants to spread operation over seven days instead of five. Assign plants a 5 day week starting on anyone of the seven days, possibly with some on 4 day 10-hour operation.
    - e) Stagger work hours. For instance, run coating lines only between 4 PM and midnight instead of 7 AM to 3 PM.
    - f) Schedule reduced work days during the smog season with or without longer days during less critical seasons. Rationing the pollution absorbing capacity.
30. An air monitoring and meteorological analysis to identify and recommend mitigation measures, for certain localized problems.
31. Adopt particulate regulation based on particle size.
32. Replace throw-away container with re-usable containers.
33. Burn solid waste near point of generation, to reduce long hauls.
34. Apply 1309 with modified trade-off of 1311 and 1311-2 clearly described as an option.
35. Requiring some sort of retrofitting on older plants. Apply BACT to newer plants through permit system.
36. Penalty charge or tax based on amount of emission to encourage reduction.
37. Lowering the reid vapor pressure of gasoline to reduce hydrocarbon emissions from storage, handling and use of motor vehicle grade gasoline.

II. Mobile Sources

1. Implement an evaporative emissions retrofit program for all vehicles.
2. Implement a catalytic retrofit program for past-71' vehicles able to operate on unleaded gasoline.
3. Adopt more stringent application of compliance procedures.
4. Adopt more comprehensive new and used motor vehicle surveillance program.
5. Adopt a mandatory vehicle inspection and maintenance program for light and heavy duty vehicles.
6. Adopt more stringent evaporative emission standards.
7. Implement a heavy duty gasoline exhaust emission retrofit program.
8. Adopt more stringent exhaust emission standards for new light and heavy duty vehicles.
9. Promote the use of new or modified fuels.
10. Promote the use of alternative power sources.
11. Establish emission standards for other mobile sources such as construction equipment, locomotives, ships, or recreational vehicles.

III. Transportation Controls

1. Measures to Improve Traffic Operations
   - A. Improve Traffic Flow
     - 1) Computerized traffic control
     - 2) Ramp Metering
     - 3) Traffic engineering improvements
     - 4) Off-street freight loading
   - B. Reduce peak-period traffic volumes
     - 1) Staggered work hours
     - 2) Four day work week
     - 3) Off-peak freight delivery
2. Measures to Reduce Vehicle Use
   - A. Restrict Vehicle Ownership
     - 1) Additional license fee
     - 2) Registration limits
   - B. Management of Auto Access
     - 1) Better enforcement of parking regulations
     - 2) Limit on number of parking spaces
     - 3) On-street parking prohibited during peak hours
     - 4) Area license
     - 5) Auto-free zones
     - 6) Gas rationing
   - C. Increase Cost of Auto Use
     - 1) Road pricing
     - 2) Increased parking costs
     - 3) Parking fee for shopper
     - 4) Eliminate free employee parking
     - 5) Increased gas tax
     - 6) Increased tolls
     - 7) "Smog charges"
   - D. Reduce the Need to Travel
     - 1) Communications substitutes
     - 2) Goods movement consolidation
3. Measures to Encourage Alternative Model of Travel
   - A. Increase Transit Ridership
     - 1) Additional transit service
     - 2) Fare reductions
     - 3) Improved comfort
     - 4) Bus and carpool lanes
   - B. Encourage Pedestrian Mode
   - C. Encourage Bicycle Mode
   - D. Encourage Ride Sharing
     - 1) Toll reduction for carpools
     - 2) Preferential parking and carpools
     - 3) Carpool matching information
     - 4) Assist vanpool formation
   - E. Promote Para-Transit Alternatives

IV. Land Use Management/ Development Controls

More effective management of all five major aspects of land development through coordinated action by cities, counties, special districts, or regional and State agencies to reduce the magnitude and frequency of auto travel:

1. Timing - expand the presently very limited application of timing controls such as growth sequence zoning, building permit quotas, staging of sewer and water intrastructure and plant capabilities, etc.
2. Quantity - expand the presently scattered application of quantitative controls on development such as performance standard zoning and limited sewer and water infrastructure and plant capacities.
3. Location - Improve the presently inconsistent application of controls on the location of development such as coordinated management of infrastructure location, annexations, public land acquisition, agricultural preserves, hillside and soil conservation, and development moratoria.
4. Density - Encourage transit usage and other non-auto modes with coordinated density policies among local jurisdictions through the application of innovative density zoning mechanisms (slope density, building height regulations, etc.) fully coordinated with service capacities and commitments.
5. Type - Reduce home-to-work & home-to-non-work travel by encouraging more land use mix, especially in terms of housing/jobs balance.

The control measures for stationary and mobile sources have traditionally been direct controls. As such they can be specified quite precisely. Many of the transportation controls and land use management measures are indirect controls. Thus, they tend to be described in more general terms. This is especially true for the land use management actions proposed. Later the basic objectives of the land use management program was presented. Simply stated the objective was to reduce the number and length of automobile trips and to increase transit use in order to decrease the amount of regional automobile travel. This would be accomplished by achieving more compact development in the region by the year 2000. Recommendations were presented for policies and actions which might begin to achieve these objectives. Clearly there may be other policies and actions which can achieve the stated objectives.

PROCESS FOR SCREENING THE OPTIONS

Having developed an inventory of about 100 control measures options, the AQMP Joint Technical Staff proceeded to screen the options down to a more manageable size. In conducting the screenings, the AQMP Joint Technical Staff attempted to avoid political judgments regarding a measure's implementability. The list of control options was screened primarily on the basis of technical effectiveness. Gas rationing serves as a good example. Nobody would debate that gas rationing could be an effective way of controlling air pollution. The debates about gas rationing center on its public and political acceptability and implementability. The AQMP Advisory Commitee argued over whether gas rationing should or should not be screened out. In the end it was included in the screened options because it is technically effective. EMTF and the public could judge its political merits and public acceptability.

The list of screened options was presented to EMTF in June, 1977 during a presentation of alternative air quality strategies. At that meeting EMTF approved the screened listing of control measures for use in developing alternative air quality strategies. These control measures were to be grouped into a series of control strategies for testing of their air quality effects.

OPTIONS CONSIDERED BUT NOT INCLUDED IN THE PLAN

Using the screened inventory of control measures as a starting point, the AQMP Joint Technical Staff analyzed the remaining control options further. Since it was clear by now that the focus for this plan was meeting the oxidant standard, control measures for particulate, SOx, CO and NOx, were eliminated (for consideration at a future time). For example, in some of the earlier progress reports, several measures were included to control sulfur dioxide emissions. Since the more detailed evaluation of the sulfur dioxide problem is proposed for the planning process, these measures were dropped from this current plan. Another example of control measures temporarily deferred is the use of best available control technology for sulfur dioxide and particulate controls. The revised best available control technology proposal concentrates on reducing hydrocarbon emissions from a number of categories.

Chapter 8

CONTROL STRATEGY ANALYSIS AND ASSESSMENT

The effectiveness of alternative control strategies in improving air quality was analyzed by using a series of computer-based models. These models have been briefly described previously:

- o The ABAG Series 3 population, housing, employment and land use modeling system.
- o The MTC travel demand models.
- o The ABAG vehicle emissions model.
- o The Livermore Regional Air Quality Model (LIRAQ) maintained by the BAAPCD.

These models were used in three distinct applications. First they were used to project future air quality assuming a continuation of existing regional growth trends and existing control programs. The results of this "baseline" projection were previously described.

Second, using the baseline projections as a starting point, an emissions sensitivity analysis was conducted to determine the range of emissions levels necessary to meet the federal oxidant standard. The purpose of this exercise was to provide information on the design of control strategies to meet the standard.

Third, a series of strategy cases were developed from the alternative control measures and tested through the modeling system for their effectiveness in improving air quality.

DETERMINING THE RANGE OF EMISSION REDUCTIONS NECESSARY TO MEET THE OXIDANT STANDARD

To define the emission reductions needed to meet the oxidant standard, the baseline emission levels were systematically reduced and analyzed by the LIRAQ model. The results of this sensitivity analysis (described in Chapter 6) showed that:

- o reduction of hydrocarbon emissions alone is more effective than joint reduction of hydrocarbon and nitric oxide emissions, for the percentages examined,
- o "Nitric oxide quenching" is a likely explanation for this result,
- o a 43% reduction of hydrocarbon emissions will attain the standard in 1985,*
- o by extrapolation of this 1985 result*, a 56% reduction of hydrocarbon emissions will attain the standard in 2000.

The conclusion should not be reached that maximizing nitric oxide emissions controls, to take advantage of nitric oxide quenching, is a viable strategy, for two reasons:

- o a California standard presently exists for one hourly average nitrogen dioxide, which is exceeded in the region,
- o the EPA is presently examining the criteria for a one to three hourly average nitrogen dioxide standard, in addition to the present annual average standard for nitrogen dioxide. EPA could issue such a standard in 1980.

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* The calculation is to apply the 43% reduction to total 1985 organic emissions. This leaves 1985 total organic emissions at approximately 450 tons/day. If a 56% reduction is applied to total 2000 organic emissions, the same remainder is obtained, 450 tons/day. Attainment dates mandated by the Clean Air Act Amendments of 1977 are 1982 and 1987; 1985 and 2000 were selected for attainment analysis before the passage of the 1977 amendments. Interpolation of 1985 result to 1982 has been made in the recently revised AQMP.

APPLICATION OF THE AIR QUALITY MODELING SYSTEM

The effectiveness of each of the strategies was more precisely determined by applying the air quality modeling system. Each measure in the strategy was translated into the appropriate variable and parameter values or into an adjustment of the emissions inventory. The methods for doing this are described below.

- Technological Controls. Technological controls were tested with relative ease because they did not involve significant changes in human activities. Rather, they involved the implementation of improved techniques for reducing the pollutant emissions resulting from normal human activities. Such emission reductions were accounted for by applying a percentage reduction factor to the "emission factors" used in the emissions models. For example, requiring even more stringent control of motor vehicle emissions than currently required was reflected in future motor vehicle emission factors. This served as input to the emissions calculations which subsequently were input to the air quality models. Regulations for controlling volatile organic compounds* or for implementing combustion modifications for reducing nitrogen oxide emission from small industrial and utility boilers were handled similarly.

- Transportation Controls. Transportation controls were tested through the travel demand modeling system. Depending on the specific nature of the controls, different approaches to simulating their effects were taken. For example, the effects of a general regionwide improvement in transit service were tested by changing the transit travel time or "wait time" in the modal split model. This produced an estimate of the percent of total trips diverted to transit and produced a net decrease in highway network traffic. Testing service improvements in specific areas involved changing the transit network to reflect the improvements. Cost incentives/disincentives such as gasoline tax or increased parking costs were simulated in the modal split model.

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* "EPA's Recommended Policy on Control of Volatile Organic Compounds" was published on July 8, 1979 (42 FR 3534)

- Land Use Controls. The effectiveness of individual land use control mechanisms could not be tested by the forecasting system in a straightforward manner. What could be tested were the ultimate objectives of land use control measures. For example, one policy goal of land use control for improving air quality was to halt the outward spread of the metropolitan area boundaries and redirect future growth into existing urbanized portions of the region. The effectiveness of specific mechanisms or tools which were employed to accomplish this result (e.g., tax incentives/disincentives, public facility restrictions, changes in general plans and/or zoning ordinances) could not be tested by the forecasting system. Instead, the system was used to test the effect of accomplishing that "compact development" policy goal on regional air quality. The land use policy goal in effect became an assumption for a subsequent reiteration of the ABAG forecasts. The results of these forecasts were then fed through the modeling sequence to produce estimates of resulting air quality. The information thus obtained was used to evaluate the air quality effects of a more compact development pattern in the region.

  Land use controls or objectives were the most difficult and time-consuming to forecast. This was due not only to the difficulties in developing clear statements of the policy goals, but also the fact that changes in the ABAG demographic forecasts necessitated additional runs of the subsequent travel demand, emissions, and air quality models.

A summary of the control strategies tested with the modeling system is presented in Table 8-1. The schematic flow diagram of the modeling system and how alternative strategies or sensitivity analyses were conducted is shown in Figure 8-1.

CONTROL STRATEGY EFFECTIVENESS

The main results of the strategy analysis are summarized in Table 8-2. The table indicates that substantial improvements in air quality can be made through the use of source control technology. It also indicates that source control technology alone will not be sufficient to meet the .08 ppm Federal oxidant standard. The transportation and land use management strategy, although relatively ineffective in the short

Table 8-1. Summary of Control Strategies Tested

MAXIMUM TECHNOLOGY STRATEGY

- Use paints and other coatings that are water based and/or have a high solids content.
- Use closed systems for storage and transfer of organic liquids.
- Use best available control technology (BACT) on new and existing sources of hydrocarbon emissions.
- Adopt more stringent vehicle (light & heavy duty) exhaust emission standards.
- Implement mandatory annual inspection and maintenance program for light and heavy duty vehicles.
- Require exhaust control devices on existing heavy duty gasoline trucks.

TRANSPORTATION AND LAND USE MANAGEMENT STRATEGY

- Increase tolls on bridges.
- Implement regional parking strategy to discourage private auto use and encourage high-occupancy auto use
    - parking tax
    - parking fees at large shopping centers
    - preferential parking for carpools, vanpools
- Provide additional transit service.
- Increase bus/carpool lanes and ramp metering.
- Implement an auto control zone in San Francisco central business district to reduce traffic.
- Provide more ride sharing services such as jitneys and vanpools.
- Develop more extensive bicycle systems.
- Achieve more compact development throughout the region by the year 2000.

COMPREHENSIVE STRATEGY

- By 1985, the comprehensive strategy includes: all of the technological control measures except for more stringent vehicle exhaust emission standards; and all of the land use/transportation measures. The effects of compact development were not included in the analysis for 1985 since the short time frame was insufficient for achieving significant results.
- By 2000, the comprehensive strategy includes: all of the technological control measures except for the exhaust control devices on existing heavy duty gasoline trucks (this measure provides short term benefits only); and all of the land use/transportation measures.

Figure 8-1

Control strategy testing with the AQMP Modeling System

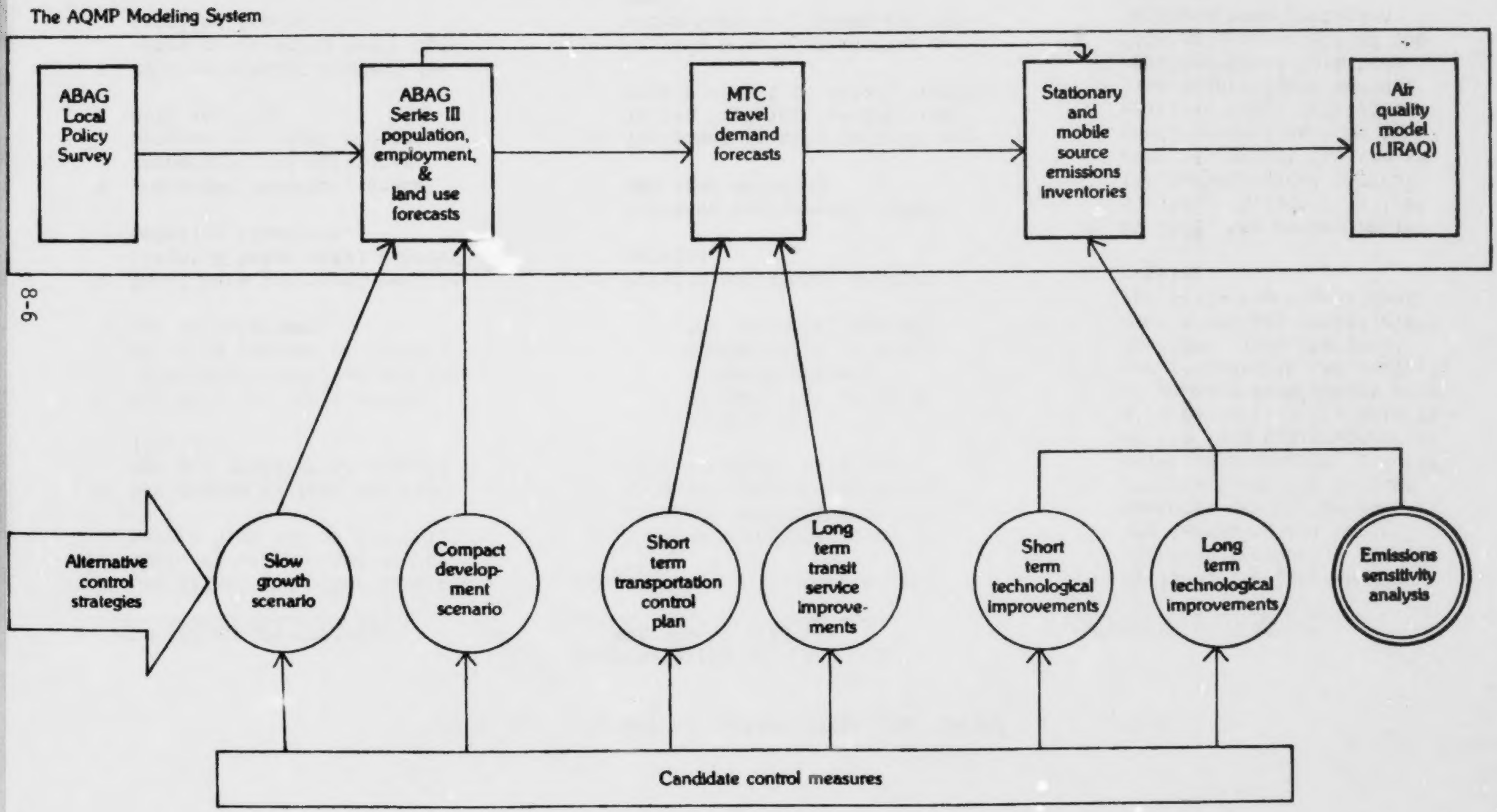

The AQMP Modeling System
ABAG Local Policy Survey
ABAG Series III population, employment, & land use forecasts
MTC travel demand forecasts
Stationary and mobile source emissions inventories
Air quality model (LIRAQ)
Alternative control strategies
Slow growth scenario
Compact development scenario
Short term transportation control plan
Long term transit service improvements
Short term technological improvements
Long term technological improvements
Emissions sensitivity analysis
Candidate control measures

Table 8-2. Effectiveness of Alternative Control Strategies

Strategy	1985			2000		
	Hydrocarbon Emission Reduction Potential	Estimated Regionwide High Hour Oxidant Level (ppm) [a]	Estimated No. of Annual Violations of the 1-Hour .08 ppm Federal Oxidant Standard	Hydrocarbon Emission Reduction Potential	Estimated Regionwide High Hour Oxidant Level (ppm) [a]	Estimated No. of Annual Violations of the 1-Hour .08 ppm Federal Oxidant Standard
Baseline (do-nothing)*	(797 tons/day) emitted	.19ppm	130	(1,058 tons/day) emitted	.24ppm	275
Maximum Technology	- 280 tons/day	.10ppm	3	- 441 tons/day	.13ppm	16
Transportation and Land Use Management	- 7 tons/day	not estimated	-	- 84 tons/day with slow growth	.23ppm	220
Comprehensive Strategy*	- 286 tons/day	.10ppm	3	- 513 tons/day with slow growth	.12ppm	11

*Does not assume New Source Review Regulation.

[a] These are extrapolated from LIRAQ modeling results.

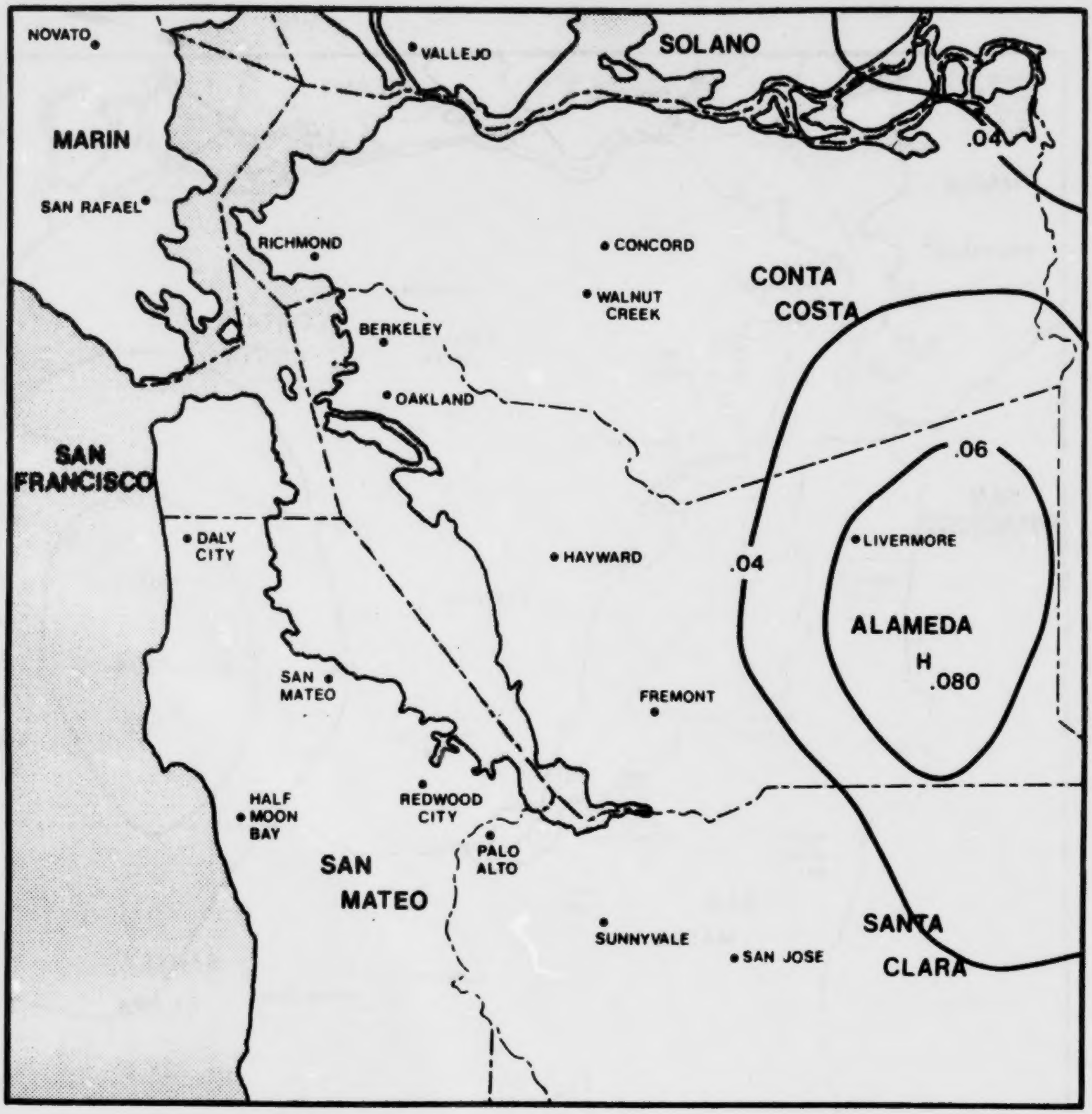
term, is shown to become increasingly effective with time. The primary value of the transportation and land use management strategy is that it helps in maintaining the air quality improvements achieved through the application of technology. Under the maximum technology strategy, air quality deteriorates significantly between 1985 and 2000 despite technology advances. The comprehensive strategy reduces this deterioration, but is still not enough to meet the Federal oxidant standard.

As previously discussed, the Federal oxidant standard upon which this strategy was based is a one hour standard, not to be exceeded more than once per year. Table 8-2 indicates that if the comprehensive strategy is implemented, the number of times the standard would be exceeded drops to approximately 3 in 1985 and 11 in the year 2000. These estimates are necessarily approximate due to the natural variation in meteorological conditions from year to year. The California standard for oxidants, at .10 ppm for one hour, would be met in 1985 under the comprehensive strategy, but would be violated in the year 2000. Figures 8-2 to 8-8 are examples of LIRAQ results for each of the strategy cases summarized in Table 8-2.

An additional analysis was conducted to test the effects of the comprehensive strategy on the three northermost counties in the region--Napa, Sonoma, and Solano. A comparison of expected oxidant levels on the LIRAQ prototype day in these counties is presented in Table 8-3 for both baseline conditions and under the comprehensive strategy. The table clearly shows a substantial improvement in oxidant levels will occur in these northern counties under the comprehensive strategy. Based on the worst case estimates and number of expected

Figure 8-2 Example LIRAQ Results - 1985 Control Strategy Analysis

(Maximum Technological Improvements Only)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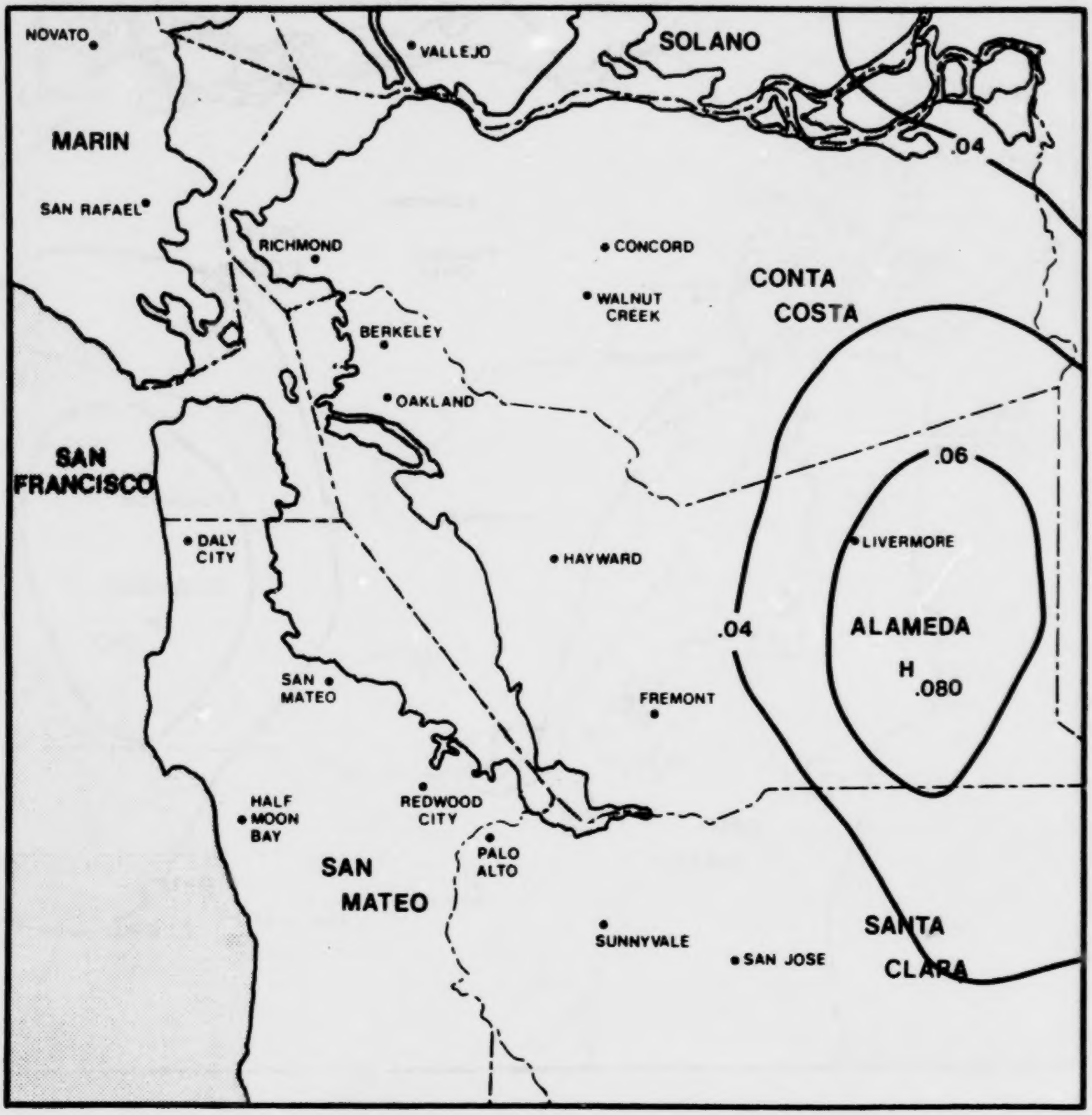
Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 1985 baseline inventory

Figure 8-3 Example LIRAQ Results - 1985 Control Strategy Analysis (Comprehensive Strategy including Additional NO_x Controls)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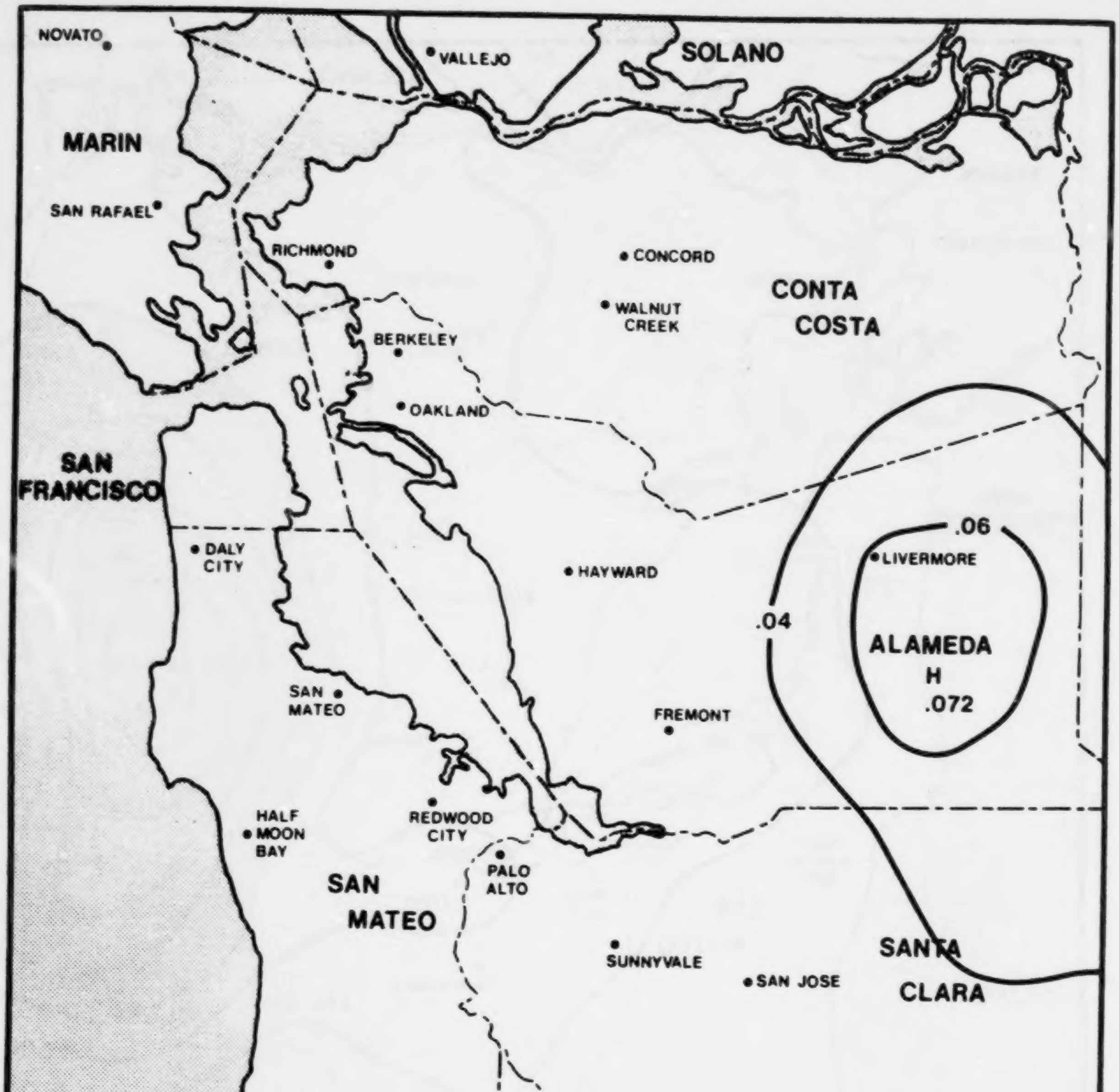
Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 1985 baseline inventory

Figure 8-4 Example LIRAQ Results - 1985 Control Strategy Analysis (Comprehensive Strategy without Additional NO_x Controls)



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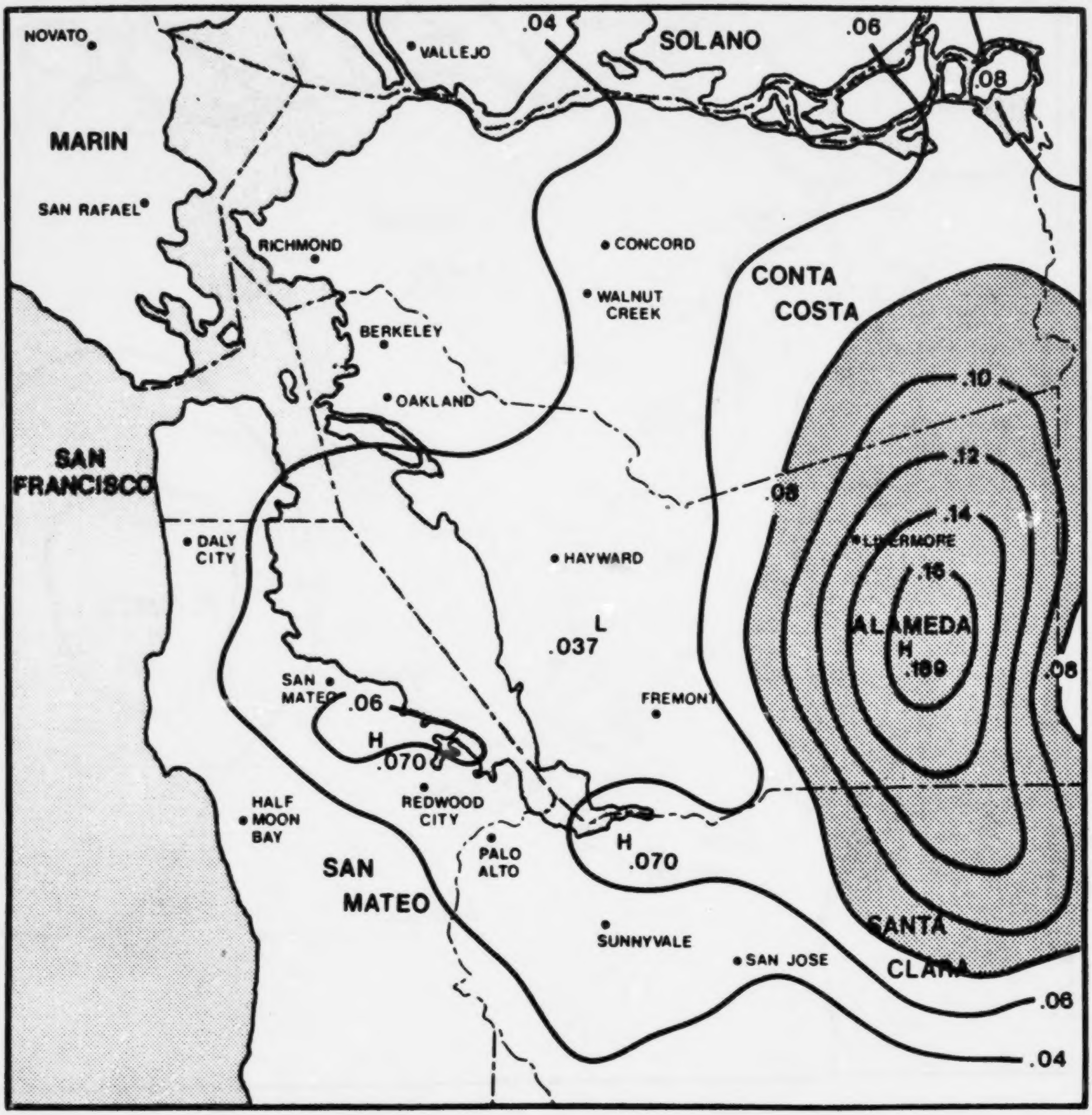
Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 1985 inventory

Figure 8-5 Example LIRAQ Results - 2000 Control Strategy Analysis (Baseline Projection Assuming Slower Population Growth Rate)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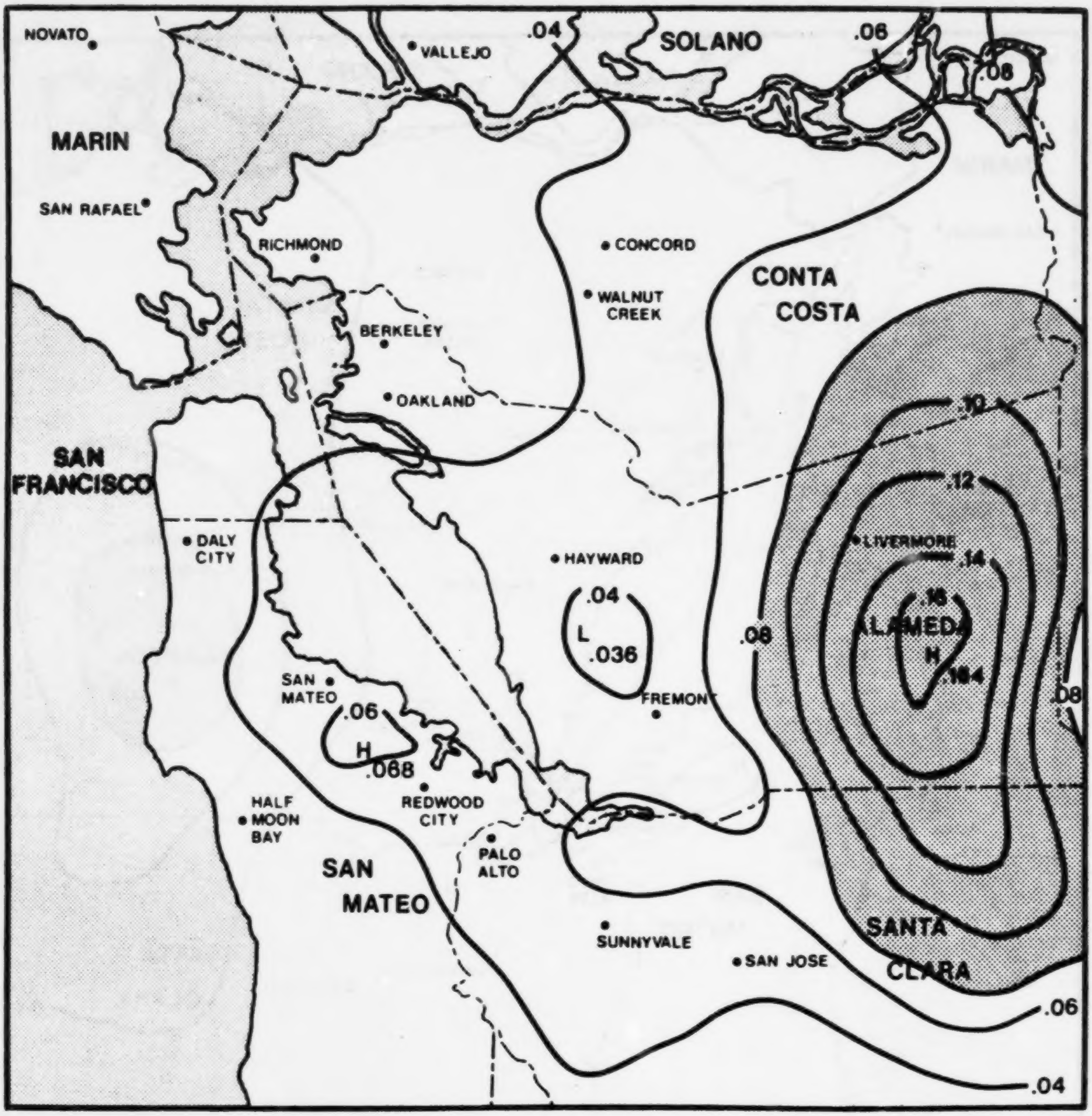
Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 2000 baseline inventory

Figure 8-6 Example LIRAQ Results - 2000 Control Strategy Analysis (Transportation Controls and Land Use Management Only)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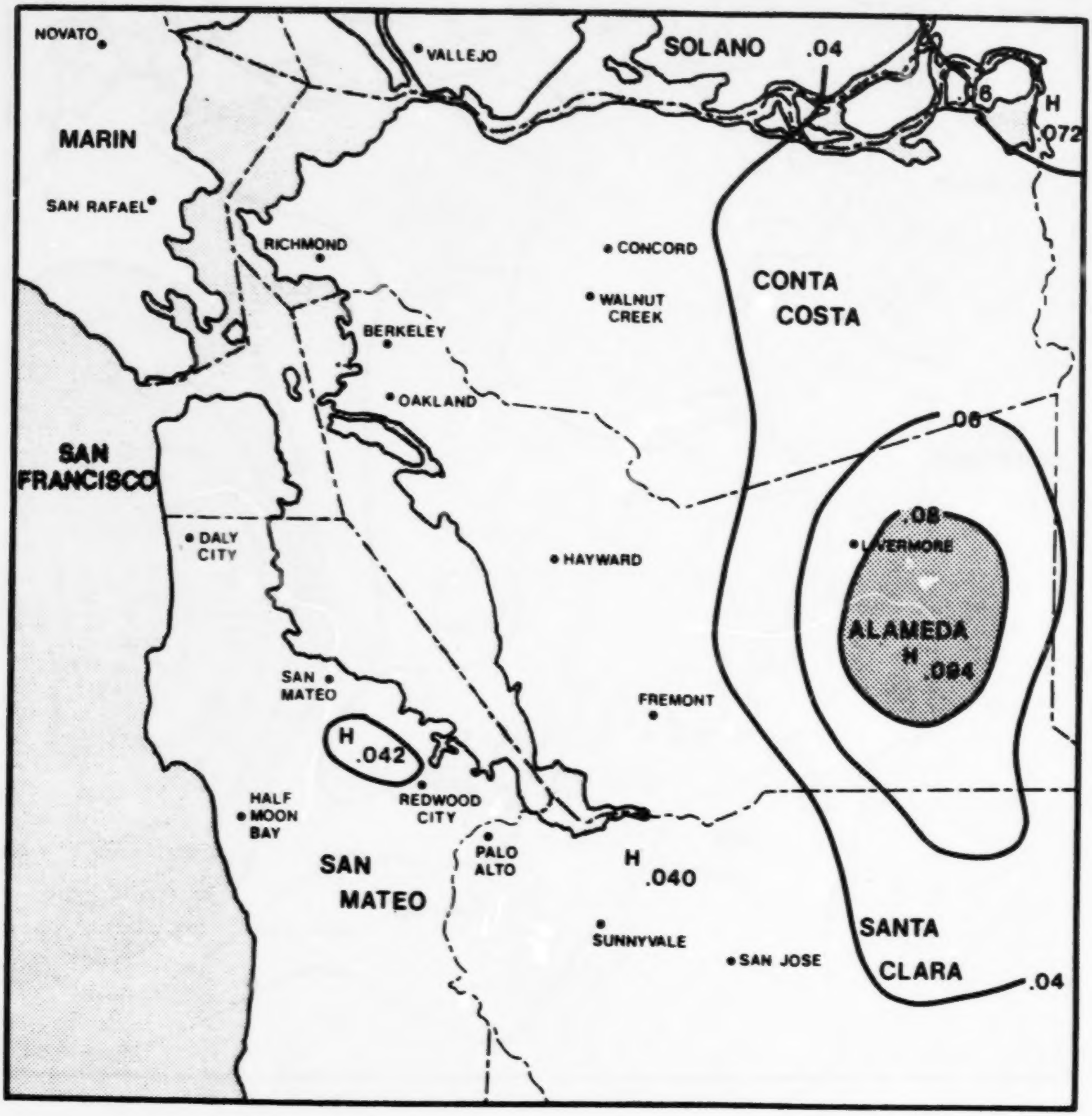
Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 2000 baseline inventory

Figure 8-7 Example LIRAQ Results - 2000 Control Strategy Analysis
(Maximum Technological Controls Only)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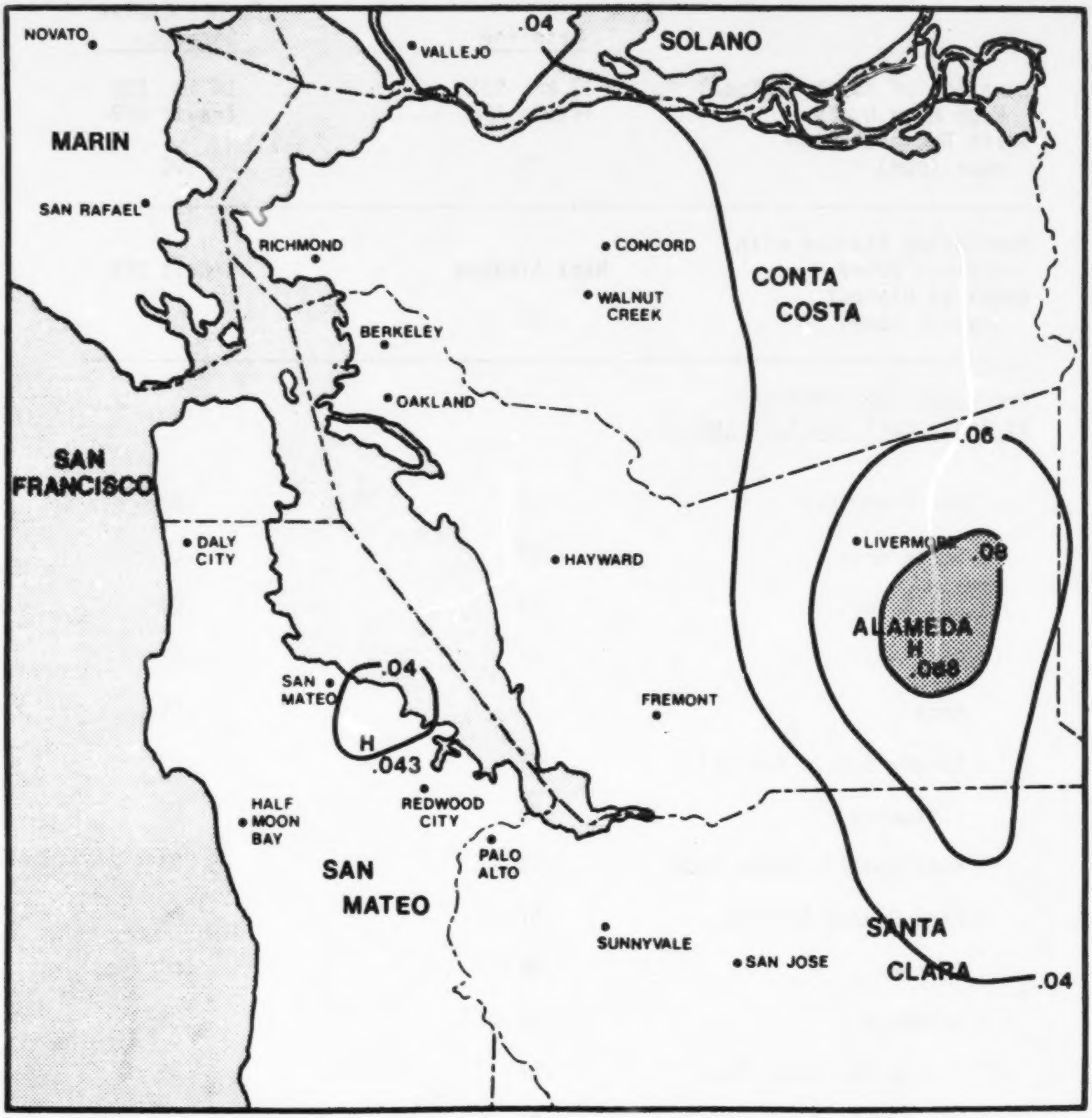
Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 2000 baseline inventory

Figure 8-8 Example LIRAQ Results - 2000 Control Strategy Analysis
(Comprehensive Strategy without Additional NOx Controls)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Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 2000 baseline inventory

Table 8-3. **LIRAQ Baseline and Comprehensive Strategy Analysis for the North Bay (2000)**

	Baseline	Comprehensive Strategy
Location of North Regional High Hour Ozone	12 km. ESE Travis AFB	14 km. ESE Travis AFB
North Regional High Hour (ppm)	.08	.06
Monitoring Station with Highest Ozone	Napa Airport	Travis AFB
Ozone at Highest Station (ppm)	.07	.06
Projected Ozone Maximum at Individual Stations (ppm)		
San Francisco	.02	.02
Santa Rosa	.04	.04
San Rafael	.03	.03
Petaluma	.04	.03
Napa	.07	.05
Sonoma County Airport	.03	.03
Pittsburg	.05	.05
Hamilton Air Force Base	.03	.03
Napa County Airport	.07	.05
Concord	.06	.04
Richmond	.04	.03
Travis Air Force Base	.07	.06
Angel Island	.04	.03
Point Bonita	.04	.03
Fairfield	.06	.05

violations for the region previously summarized in Table 8-2, it is expected that the oxidant standard will also be met in the northern counties under the comprehensive strategy.

COSTS OF PROPOSED STRATEGIES

As part of the overall assessment of alternative strategies, estimates of direct program costs were made. In each of the major control areas, direct costs (including capital, operating and maintenance) were analyzed and converted into equivalent annual costs. The cost analyses of various control programs are described in detail in AQMP and its technical appendices (8-1, 8-2), the following summarizes the analyses results.

Stationary Source Control Costs

The major costs for additional stationary source controls would be for meeting best available control technology requirements. It is estimated this would cost about $30 million annually. Most costs would be borne by private industry for capital outlays and higher operating and maintenance costs. An increase in public sector expenditures is also estimated for increased administrative and regulatory costs. These latter costs are estimated to be about two percent (or approximately $600,000) of the costs of this program.

For private industry, slightly more than half of the costs are increased operating and maintenance expenses, which are recurring costs. The capital outlay requirements of approximately a half billion dollars would be expended in the early 1980's if the plan were carried out as scheduled.

No direct costs are associated with continued implementation of the New Source Review rule. Since this regulation has been in effect for a number of years, the administrative and regulatory costs are already included in the budget by the Bay Area Air Pollution Control District. Any of the options currently being considered to modify the New Source Review rule are estimated to cost about the same to carry out as the existing rule.

Mobile Source Control Costs

The annualized costs for additional mobile source controls is approximately $50 million. These costs would pay for three very different programs. About half of the $50 million is estimated to be the added per vehicle costs for cars and trucks which meet more stringent exhaust emissions standards. The additional cost per vehicle would likely range between $200 and $400, assuming that a new engine technology is used to meet both the more stringent emission standards and Federal fuel economy standards. It has been assumed that these cars would be produced for all of California at a minimum, and possibly in a few other states with severe air pollution.

The vehicle inspection and maintenance program would cost about $20 million annually. This cost includes a $5 per vehicle inspection fee and an average repair cost of $45 per vehicle, both paid by the vehicle owner. The $5 inspection fee will cover the costs of acquiring land, constructing inspection facilities, equipment, and operation of the facilities. An additional aspect of the program would be that no vehicle owner would be required to spend more than a given amount (e.g., $75) on repairs related to emission control.

The retrofit of heavy-duty gasoline powered trucks with exhaust catalysts is estimated to cost $340 per vehicle, or a total annualized expenditure of $1.5 million for the region. This cost includes a 50,000 mile replacement warranty. The slight increase in operating cost due to the use of unleaded gasoline will be offset by a slight improvement in fuel economy.

Land Use and Transportation Control Costs

Costs associated with the land use and transportation recommendations are more complex than the costs for stationary and motor vehicle emission controls. In many cases a redistribution of money within the region is the net result. For example, the cost of the bridge toll increase and the parking tax become revenues to support improvements in public transit systems. About $18 million annually would be expended in this way. There are many hidden subsidies given to the use of the private automobile including a variety of public services (judicial system, coroner, fire department, on street parking, city planning, and other services typically financed from property taxes), and local ordinances which require parking to be provided by residential, commercial, and industrial developments. Because these subsidies are not structured on a "user pays" basis, there are existing inequities in the way transportation systems are financed. The use of bridge tolls and parking taxes to support transit service improvements could be viewed as a redistribution of subsidies from one transportation system to another. The land use recommendations support a more compact development pattern for the region than would occur under existing city and county land use policies. The direct cost of implementing these recommendations are of an administrative or regulatory nature. These costs will be estimated after the specific policies and actions to be implemented by each jurisdiction in the region are agreed upon. Indirect costs such as cost impacts on land, housing, commerce, etc. are addressed in the overall assessment.

The costs associated with the carpool incentive programs (preferential parking, bus/carpool lanes on freeways with ramp metering, and an expanded carpool matching program) total about $9 million annually. The bulk of these costs are due to construction requirements for the bus/carpool lanes and ramp meters.

Finally, the cost of implementing a comprehensive system of bicycle paths and storage facilities is estimated to be approximately one-half million dollars per year. It was assumed that the paths would be striped onto existing roadways where the additional road width required would be accommodated by narrowing existing vehicle lanes.

Cost-Effectiveness of AQMP Recommendations

The cost-effectiveness of the various AQMP recommendations can be generally estimated in terms of the cost per ton of hydrocarbon emissions prevented, as summarized below:

- The stationary source control recommendations would cost between $200 and $1000 per ton of hydrocarbon emission reduced, depending on the cost assumptions employed.*

- The motor vehicle emission control recommendations would cost approximately $1000 per ton of hydrocarbon emissions reduced;

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*According to the cost conventions used for all control measures and described in References 8-1 and 8-2, the cost-effectiveness of stationary source controls would range from $200 to $300 per ton. However, stationary source control costs are (1) heavily weighted toward capital outlays for control facilities, which (2) have a shorter useful lifetime than assumed for all control measures (10-15 years rather than 25 years). Using these latter assumptions, the cost-effectiveness would be approximately $1000 per ton.

o The land use and transportation recommendations would cost approximately $10,000 per ton of hydrocarbon emissions reduced, assuming no net dollar costs or benefits due to the land use recommendations.

These estimates would indicate to some what the priority for implementation of the various recommendations should be. Stationary source controls are clearly the most cost-effective within the time frame of this plan. The land use and transportation recommendations would appear to be relatively expensive; however, this conclusion is also only valid during the time frame of this plan. The effectiveness of implementing the land use and transportation recommendations are expected to increase with time beyond the year 2000.

References

8-1, Associations of Bay Area Governments, "Appendix G, Air Quality Technical Materials, San Francisco Bay Area Environmental Management Plan," Berkeley, California, June, 1978

8-2 Kan, I, "Effectiveness and Costs of Alternative Air Pollution Control Programs," Technical Memorandum 14 in Appendix G, Air Quality Technical Materials, San Francisco Bay Area Environmental Management Plan, Association of Bay Area Governments, California, June, 1978

Chapter 9

DEVELOPMENT OF STAFF RECOMMENDED DRAFT PLAN

Analysis described in the previous section showed how a comprehensive strategy could have substantial air quality improvement on the region. Despite these improvements, however, the results show violations in the 0.08 ppm standard in 1985 and 2000. From the sensitivity analyses, it was estimated that less than 450 tons/day of hydrocarbon emissions would be permissible for the standard to be attained. Additional hydrocarbon emission reductions needed beyond the comprehensive strategy are shown in Table 9-1. Two basic options were available to the region to demonstrate further emission reductions to meet the standard:

- o Additional controls on existing sources
- o Management of the growth of new sources and indirect sources.

A description of these options is provided below.

ADDITIONAL CONTROLS ON EXISTING SOURCES

Table 9-2 summarizes additional control measures that could be applied to provide the final increment of control necessary to attain standard. These measures were not analyzed to the same level of detail as the measures in the comprehensive strategy.

Table 9-1. Hydrocarbon Emission Reductions Required to Achieve the 0.08 PPM Photochemical Oxidant Standard

	1985 (Tons/Day)	2000 (Tons/Day)	
Base Line Emissions	797	1058	
Allowable Hydrocarbon Emissions[a]	< 450	< 450	
Hydrocarbons Remaining After Implementing Comprehensive Strategy	511	604[b]	545[c]
Additional Hydrocarbon Reductions Needed to Meet Standard	> 61	> 154[b]	95[c]

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[a] Varies as a function of oxides of nitrogen emissions and the spatial and temporal distribution of all precursor emissions.

[b] Assumes upper range of population forecast in Series 3 projections--6.1 million people in 2000.

[c] Assumes lower range of population forecast in Series 3 projections--5.4 million people in 2000.

As noted in the Table, the lowered Reid Vapor Pressure of gasoline would result in a 2 to 4% reduction of HC emissions. However, it would produce the undesirable side effect of making vehicle engines difficult to operate in cold weather. If only small changes in vapor pressure are required, engine start-up and warm-up problems are minimal but the corresponding effectiveness of this measure is also minimal. This program has been studied in the past on a number of occasions. A study being conducted by the American Petroleum Institute has concluded this

Table 9-2. Additional AQMP Control Measures for Existing Sources and Approximate Emission Reduction Potentials[a]

	1985		2000	
	T/D	(%)	T/D	(%)
Stationary Sources				
o Lower Reid Vapor Pressure	15-30	2-4	20-35	2-3
o Ban Small Gasoline Engines (e.g., Lawnmowers)	10-15	1-2	20-30	2-3
Mobile Sources				
o Catalytic Converter Retrofit ('71-'74 LDV)	6	0.6	0	0
o Evaporative Retrofit (pre-1978)	4	0.4	0	0
Transportation Controls				
o Increased Gas Tax	3-5	0.3-0.6	To be implemented with land use management measures	
o Area License				
o Smog Charges				
o More Stringent Application of Previously-cited Transportation Controls				
Other				
o Gasoline Rationing	Variable impact depending on stringency of application and user groups affected. (A 100% rationing program could yield an additional 170 ton/day emission reduction by the year 2000.) Obviously, a very direct and potentially effective means of reducing hydrocarbon emissions.			
o Prohibiting Certain Organic Solvent Use	Variable impact depending on stringency of application. (A 100% prohibition could yield an additional 160 ton per day emission reduction by the year 2000.) This measure assumes going considerably beyond the use of water-based and high solids content solvents and BACT on organic solvent evaporation.			

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[a] Assumes prior implementation of the Comprehensive Strategy.

proposal has very limited potential as an air pollution control measure. The technical feasibility of this measure is questionable. Therefore, it did not appear to be an attractive option for the AQMP.

A ban on the use and/or sale of small gasoline engines would include lawnmowers, chain saws, small gasoline powered pumps and generators, etc. In some cases alternatives can be found such as electric lawn mowers; however, these alternatives were seen to have other undesirable characteristics in terms of inconvenience (small gasoline engines are ideal for use in situations where electrical power is not conveniently available). Enforcement of this measure could be difficult. This measure has many very obvious administrative and implementation obstacles associated with it. It was not considered to be an attractive option for the AQMP.

The catalyst and evaporative retrofit measures for light duty vehicles are marginally effective by 1985 and decrease in effectiveness as the retrofitted vehicles age and are eventually junked. Previous retrofit programs attempted by the California Air Resources Board have been unpopular, since there are no direct benefits to the vehicle owner. These programs have a very short-term benefit and require rapid adoption and implementation to achieve their greatest potential. Given the many technical problems associated with retrofit programs in the past, these control measures were not considered an attractive option for the AQMP.

The transportation controls listed can yield emission reductions shown if stringently applied. For example, a 300% increase in the cost of gasoline via a gasoline tax would yield an approximately 1 to 2 tons/day hydrocarbon emission reduction in 1985. A close assessment of any particular proposals is recommended prior to inclusion in the plan.

The measures listed as "other" can yield a range of emission reductions depending on how stringently they are applied. A 100% gasoline rationing program would yield an additional emission reduction of about 170 tons/day by the year 2000, assuming prior implementation of the comprehensive strategy. A 100% prohibition on organic solvent use in the region could yield an additional emission reduction of about 160 tons/day beyond the comprehensive strategy. The effectiveness of intermediate levels of stringency are difficult to estimate, but are expected to be somewhat less than proportional. The impacts of these measures are also variable depending on the stringency of their application. Again, because of the very obvious problems associated with implementing these measures, they did not appear to be attractive options for the plan.

MANAGEMENT OF THE GROWTH OF NEW SOURCES AND INDIRECT SOURCES

An alternative to additional control over existing sources is to manage the growth of new sources and indirect sources of emissions. New Source Review (NSR) was excluded from the air quality evaluation of the comprehensive strategy for a number of reasons:

- NSR is of variable effectiveness, depending on how stringent the adopted rule is (e.g., off-set provisions).
- The specific form of NSR appropriate and acceptable to regional, State and Federal regulatory agencies has been and continues to be debated.
- It is more appropriate to compare the effectiveness of NSR with respect to other control programms using a common baseline forecast. Such a forecast should not already include an NSR assumption.

In considering alternatives for attaining and maintaining the oxidant standard after all reasonably available controls have been implemented, NSR is of interest. Its effectiveness can range from zero to a maximum of approximately 200 tons/day reduced by the year 2000. The specific level of effectiveness achieved depends on the number and type of sources subject to review, and the specific review criteria used for determining compliance.

Indirect Source Review (ISR) is the counterpart to New Source Review for sources that do not directly emit pollutants, but which cause or induce emissions from other sources. Shopping centers, parking lots, and airports are examples of indirect sources of pollution. The land use management recommendations in the comprehensive strategy would rely heavily on implementation by local governments, with no real mechanisms for ensuring consistent implementation from one jurisdiction to another across the region. An Indirect Source Review program conducted at the regional level would provide the necessary mechanism. The Bay Area Air Quality Management District has the legal authority to implement such a program. With specific technical assistance from the Metropolitan Transportation Commission and the Association of Bay Area Governments, the BAAQMD could administer an ISR program for the region.

New Source Review and Indirect Source Review were determined to ensure sufficient hydrocarbon emission reduction to allow attainment of the oxidant standard and continued maintenance thereafter. In addition, NSR and ISR regulations are such that they can provide some degree of flexibility. Initially strict regulations can be changed and relaxed somewhat after it has been demonstrated that the air quality standards can be attained and maintained in spite of such relaxation.

The role of the NSR/ISR programs in relation to the comprehensive strategy and baseline air quality is illustrated in Figure 9-1. The comprehensive strategy is shown to provide the bulk of the air quality improvement between now and the year 2000, while the role of the NSR/ISR programs would be to provide the incremental emission reduction (or prevention) necessary to attain and maintain the federal oxidant standard. As the comprehensive strategy is made more stringent, restrictions on new source development can be made less stringent, and vice versa.

THE STAFF-RECOMMENDED DRAFT PLAN

The draft air quality maintenance plan recommended was comprehensive and included a broad range of control programs for photochemical oxidants. It called for more controls on stationary sources of air pollutants and on motor vehicles. It also included proposals for changes in the region's transportation systems and for management of development to achieve compact growth.

The recommended application of improved technological controls to stationary sources and motor vehicles would produce the most substantial improvements in air quality. The transportation and development measures would act together to reduce automobile traffic, a major source of air pollutant emissions. The stationary and mobile source controls, together with transportation and development measures and new and indirect source review programs, would ensure eventual attainment and long-term maintenance of the Federal oxidant standard.

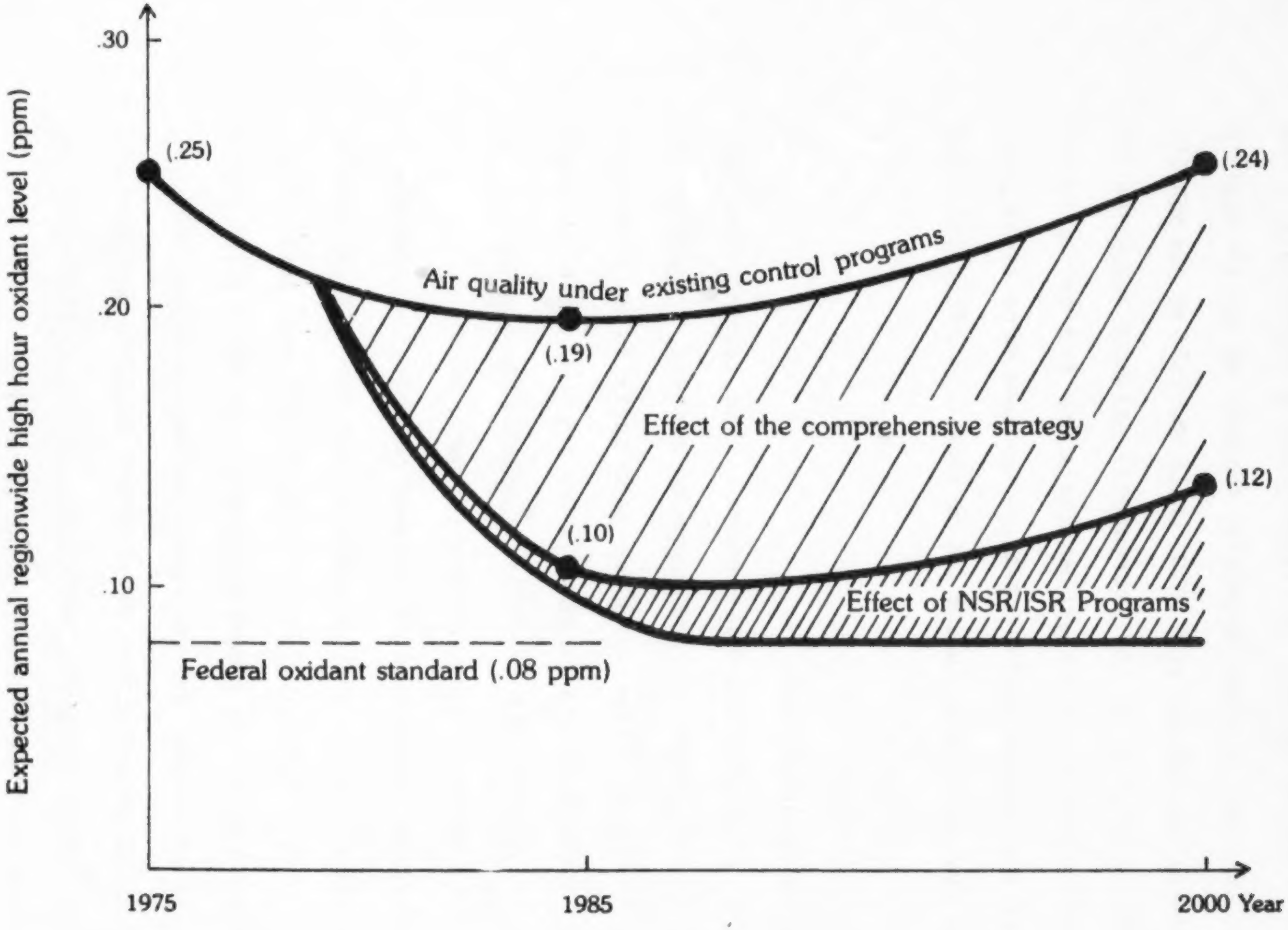


Figure 9-1

Relative roles of new source review/indirect source review programs and the comprehensive strategy in achieving and maintaining the Federal oxidant standard in the San Francisco Bay Region.

The draft plan recommendations are summarized in Table 9-3. For each action listed in the first column, subsequent columns of the table indicate the agencies responsible for implementing the action, the implementation schedule, costs, sources of financing and direct benefits in terms of emission reductions. Other environmental, institutional/financial, economic, and social impacts of the actions were also presented in the draft plan.

Figure 9-2 highlights in graphic form the schedule for implementation of each of the plan recommendations. Most of the recommendations could be adopted by appropriate agencies within two years of plan approval. However, full implementation would realistically require several years beyond the adoption phase, particularly for the most significant programs such as the use of best available control technology (BACT). It is therefore unlikely that the oxidant standard can be met in the Bay Area by 1982. The ultimate 1987 target year for attainment set by the 1977 Clean Air Act Amendments can be met through implementation of this plan.

Table 9-3. Draft Oxidant Plan Recommendations

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day)		IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
	1985	2000					
I. Stationary source controls GENERAL POLICY: MINIMIZE HYDROCARBON EMISSIONS FROM STATIONARY SOURCES							
Action 1 Use paints and other coatings that are water based and/or have a high solids content.	60	80	Bay Area Air Pollution Control District (BAAPCD)	A - 1978 to 1980 I - 1985	$7,170,000[b]	Administrative/Regulatory - Ad valorum tax revenues - ARB subvention Funds - Federal Clean Air Act funds Operating/Maintenance - Private Capital - Private - California Pollution Control Financing Authority - Federal Small Business Administration Loan Programs	BAAPCD Enabling Legislation
Action 2 Use closed systems for storage and transfer of organic liquids.	40	65	BAAPCD	A - 1978 I - 1983	$17,000,000[b]		BAAPCD Enabling Legislation
Action 3 Use best available control technology (BACT) on new and existing hydrocarbon sources.	227	339	BAAPCD	A - 1980 I - 1985	$529,000[a] $29,331,000[b]		BAAPCD Enabling Legislation
Action 4 Continue the review of new & modified industrial and commercial facilities (new source review)	Variable, depending on the stringency of application. Maximum effect of 64 tons/day of hydrocarbon emissions reduced in 1985 and 200 tons/day in 2000.		BAAPCD	Currently being implemented	No direct costs		BAAPCD Enabling Legislation
II. Mobile source controls GENERAL POLICY: MINIMIZE HYDROCARBON EMISSIONS FROM MOTOR VEHICLES							
Action 5 Implement more stringent vehicle (light duty and heavy duty) exhaust emission controls--approx. 50% reduction below 1977 prescribed levels.	-	62	California Air Resources Board (CARB)	A - 1980 I - 1990	$3,000[a] $24,910,000[b]	- Private	Mulford-Carrell Air Resources Act
Action 6 Implement inspection/maintenance program for light and heavy duty vehicles.	23	58	CARB and/or Bureau of Automotive Repair	A - 1978 I - 1985	$1,395,000[a] $16,892,000[b]	- I/M Program revenues - State General Fund	New Legislation Required

Action 3:

PROCESS	TECHNOLOGY
Organic storage	Dual & parallel vapor recovery
Tar pots	Loading door assembly
Paint spray booth	Incinerator or low/no solvent coatings
Architectural coating	Low solvent coatings
Dry cleaning	Closed system with solvent recovery
Chemical milling, plating	Fume scrubbers (packed bed)
Cable tar coating	Incineration
Gasoline bulk storage	Floating roof or fixed roof & vapor recovery
Auto service station storage tanks	Closed balanced system with secondary system
Auto fill operations	Secondary vacuum assist system

[a] Public agency

[b] Private

Table 9-3. (Cont'd)

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day)		IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
	1985	2000					
Action 7 Require heavy duty gasoline exhaust control devices on existing vehicles.	25	-	CARB	A - 1979 I - 1985	$8,000[a] $1,534,000[b]	- Private	New Legislation Required
III. Transportation controls							
GENERAL POLICY: REDUCE MOTOR VEHICLE EMISSIONS THROUGH TRANSPORTATION ACTIONS TO REDUCE VEHICLE USE							
Action 8 Increase tolls on bridges.	0.2	Not estimated separately; included below with emission reductions due to compact development	Metropolitan Transportation Commission (MTC) and California Toll Bridge Authority	A - 1980 I - 1980	($13,000,000[b])	- Toll revenues	AB 664
Actions 9 & 10 Implement regional parking strategy to discourage private auto use and encourage high-occupancy auto use.			Cities, counties, employers, MTC			- Parking charges	Local Municipal Tax Enabling Legislation
Action 9 - Parking tax	0.3			A - 1980 I - 1981	$15,000[a] $(6,000,000[b])		
Action 10 - Preferential parking for carpools and vanpools	0.1			A - 1978 I - 1985	$886,000[a]		
Action 11 Provide additional transit service.	0.7		MTC, transit districts (e.g., MUNI, AC, BART)	A - 1978 I - 1985	$18,540,000[a]	- Federal Mass Transportation Assistance Programs - Fare revenues - Local Transportation Development Act Funds - State Highway Trust Fund diversions	- Local Transit District Enabling Legislation - Bay Area Rapid Transit District Enabling Legislation - Interagency Memoranda of Understanding
Action 12 Increase bus and carpool lanes/ramp metering.	0.2		Caltrans, transit districts, cities and counties	A - 1979 I - 1985	$7,438,000[a]	- Federal Aid Highway Programs - State Highway Programs funds	- AB 69 (State Transportation Planning Enabling Legislation) - AB 363 (Bay Region Transportation Planning Legislation) - Caltrans Enabling Legislation - Local Planning and Traffic Control Enabling Legislation
Action 13 Implement an auto control zone in San Francisco central business district to reduce traffic.	0.1		City of San Francisco	A - Previously adopted I - 1980	$128,000[a]	- City General Funds - Local Transportation Development Act Funds	San Francisco Traffic Ordinances

[a] Public agency

[b] Private

Table 9-3. (Cont'd)

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day)		IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
	1985	2000					
Action 14 Provide more ride sharing services such as jitneys and vanpools.	1.7	Not estimated separately; included below with emission reductions due to compact development	Caltrans, Employers, MTC	A - Previously adopted I - 1979	$300,000[a]	- Federal Mass Transportation Assistance Programs	Federal Energy Legislation
Action 15 Develop more extensive bicycle systems.	2.0		Cities, counties, MTC, Caltrans	A - 1980 I - 1985	$438,000[a]	- Federal-Aid Highway Programs - Local Transportation Development Act Funds	- Federal-Aid Highway Legislation - Local Transportation Development Act Legislation

[a] Public agency

[b] Private

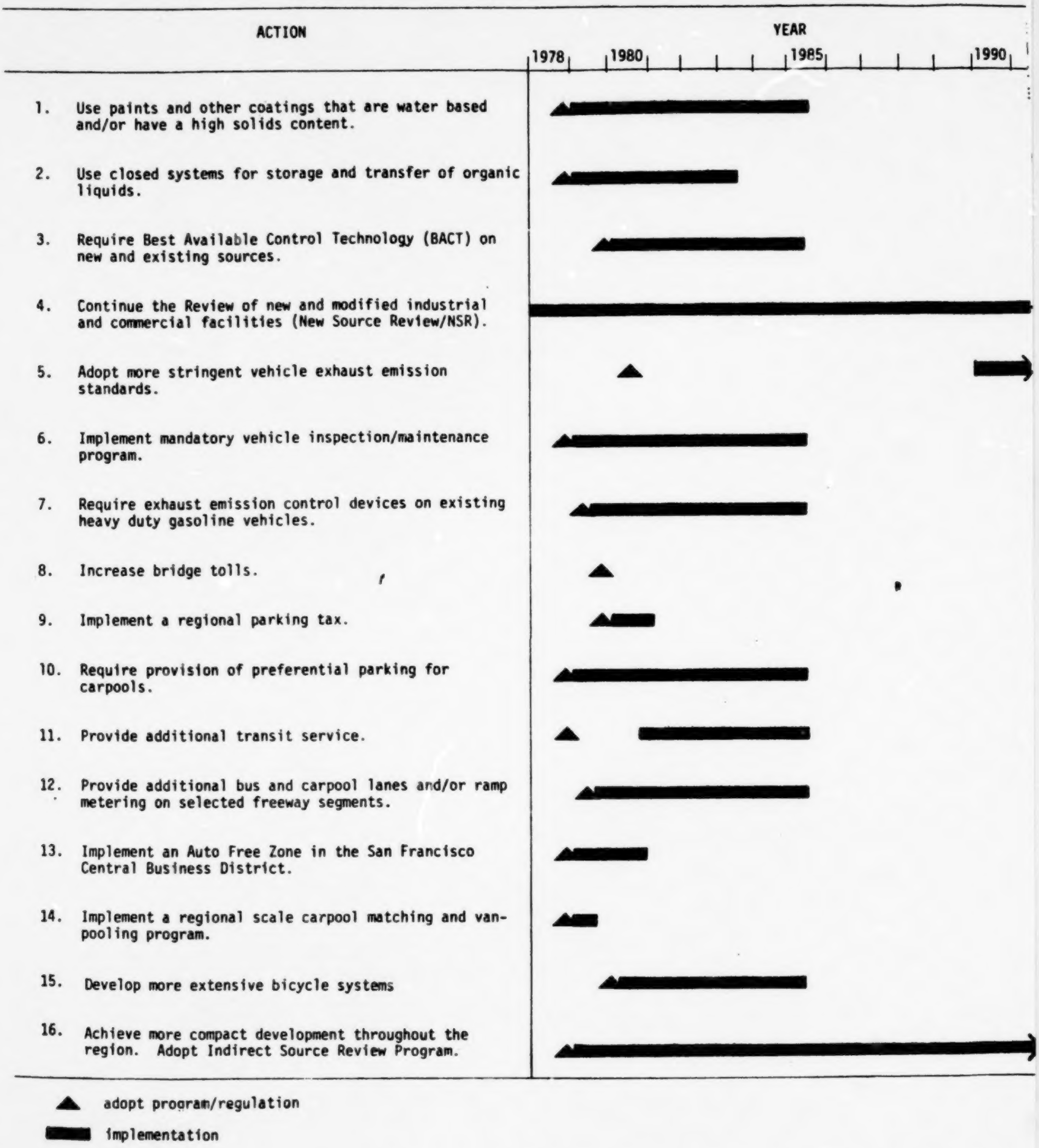
IV. Development and land use management

GENERAL POLICY: ALTER REGIONWIDE DEVELOPMENT PATTERNS TO REDUCE AUTOMOBILE TRAVEL BY MEANS OF LOCAL AND REGIONAL POLICIES ON LAND USE AND URBAN SERVICES

RECOMMENDATIONS	1985	2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
The reductions in emissions are based on a total population in the region of 5.4 million. If the population were at the higher range projected (6.1 million), the emission reductions shown would be higher, but so would the total from which the reductions would be subtracted.	Not estimated	24	Cities, counties, Local Agency Formation Commissions, special districts, ABAG, BAAPCD, MTC, State Water Resources Control Board, California Department of Transportation, U.S. Department of Transportation, Environmental Protection Agency	A - 1978 I - 2000	Direct administrative and regulatory costs to be estimated when agencies specify actions they will take to carry out recommendation for compact development.	Depends on specific actions	Existing authority contained in California Government Code; Health and Safety Code; State Constitution; relevent Federal legislation.

(Editor's Note: The draft AQMP proposed 16 policies and 49 actions to implement the general policy on land use and development management. They are not listed here for brevity's sake.)

Figure 9-2 SCHEDULE FOR IMPLEMENTATION OF THE AIR QUALITY MAINTENANCE PLAN



1. Use paints and other coatings that are water based and/or have a high solids content.
2. Use closed systems for storage and transfer of organic liquids.
3. Require Best Available Control Technology (BACT) on new and existing sources.
4. Continue the Review of new and modified industrial and commercial facilities (New Source Review/NSR).
5. Adopt more stringent vehicle exhaust emission standards.
6. Implement mandatory vehicle inspection/maintenance program.
7. Require exhaust emission control devices on existing heavy duty gasoline vehicles.
8. Increase bridge tolls.
9. Implement a regional parking tax.
10. Require provision of preferential parking for carpools.
11. Provide additional transit service.
12. Provide additional bus and carpool lanes and/or ramp metering on selected freeway segments.
13. Implement an Auto Free Zone in the San Francisco Central Business District.
14. Implement a regional scale carpool matching and vanpooling program.
15. Develop more extensive bicycle systems
16. Achieve more compact development throughout the region. Adopt Indirect Source Review Program.

Chapter 10

PLAN REVIEW, ADOPTION AND APPROVAL PROCESS

Air quality actions to attain and maintain the Federal oxidant standard in the Bay Area were contained in one chapter of the Association of Bay Area Government's Environmental Management Plan.

Neither the Clean Air Act nor the Federal Water Pollution Control Act--the major Federal legislation under which ABAG's Environmental Management Plan is developed and maintained--specify a local approval process for required plans. The Clean Air Act does require that a State adopt the State Implementation Plan, but the 1977 Amendments provide for a somewhat different approach.

While the 1977 Amendments retain the provision for State adoption, the portion of the SIP for a non-attainment area, where possible, shall be prepared by an organization designated under Section 174 of the Act. The same plan is required by Section 172 to include evidence of public and local government involvement and consultation. It is also required to include evidence that the State, the general purpose local governments, or a regional agency designated by general purpose local governments, have adopted by legally enforceable means (such as statutes, regulations or ordinances) the necessary requirements, schedules, timetables for implementing controls and are committed to implement and enforce the appropriate elements of the plan.

Thus, while no specific provisions for a local adoption process are included in the Act, certain points ought to be considered:

1. The lead agency, if it is assigned by the plan certain responsibilities, should provide evidence of its commitment by policy board action.
2. Other implementing agencies, by similar action, should indicate their commitment to carry out control measures or strategies included in the plan.
3. The State, while sharing authority/responsibility for the preparation of the SIP provisions for non-attainment areas, retains the responsibility to adopt the plan.

Another significant principle in plan adoption does not emerge directly from the Act, but indirectly from the philosophy underlying the 1977 Amendments. To provide for an implementable plan--and to effectively consider the social and economic consequences of carrying out that plan--there ought to be an orderly process for local plan approval and concomitant public participation in that process.

In the Bay Area, the principles described above were used in designing the specific approval process for the Bay Area's Environmental Management Plan. Key features in that process relevant to air quality planning were:

1. Stationary source controls, which would be implemented locally by the Bay Area Air Quality Management District, were prepared by the BAAQMD* staff and adopted by the District Board prior to ABAG action.
2. Similarly, transportation measures were prepared and adopted by the Metropolitan Transportation Commission.
3. ABAG's approval schedule allowed considerable time for public participation and to allow local elected officials of the region to fully consider divergent viewpoints in adopting a plan to be submitted to the State.

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*formerly the BAAPCD

PROVIDING ADEQUATE TIME FOR PUBLIC REVIEW

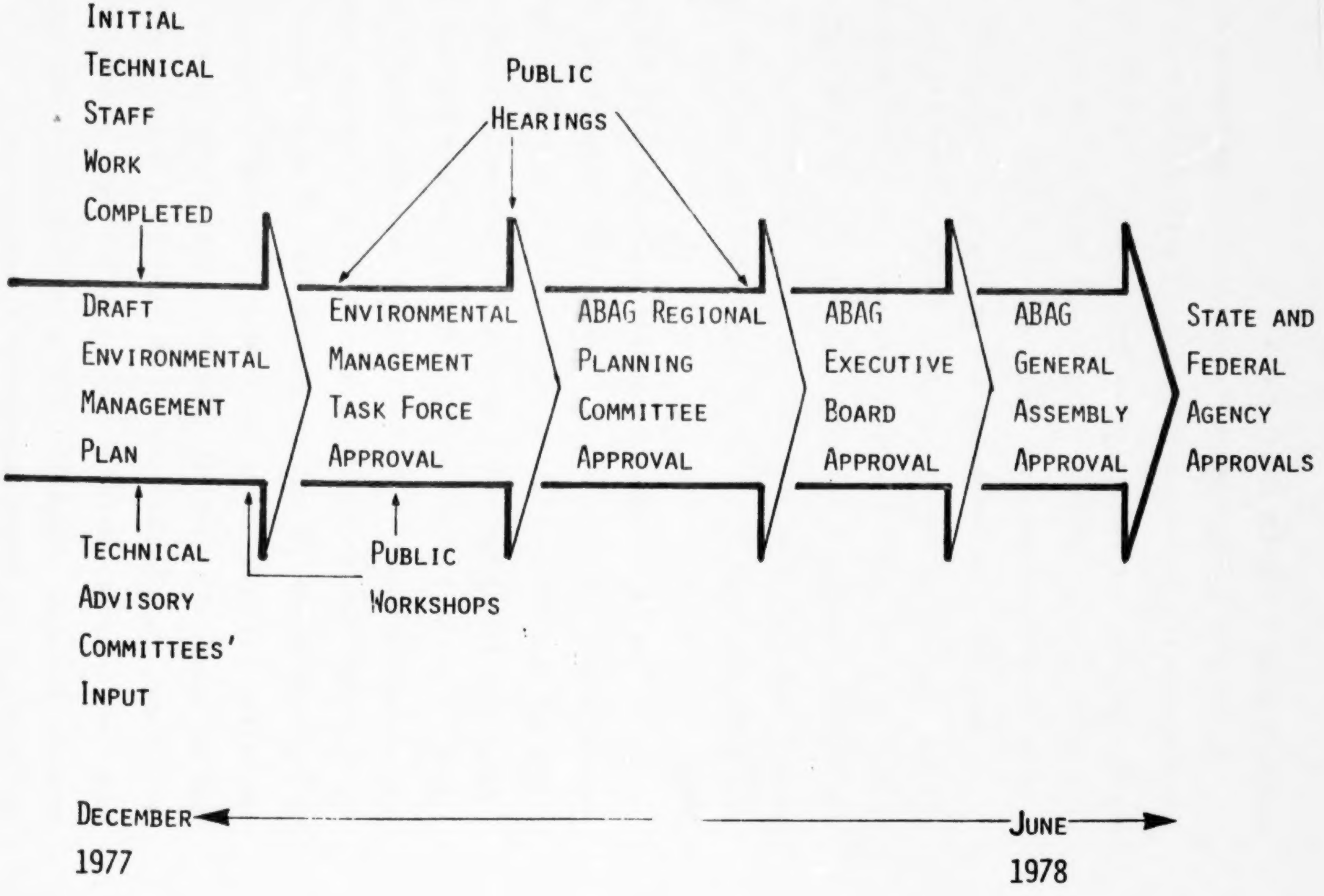
The Environmental Management Plan was drafted as an integrated air and water quality, water supply, and solid waste plan for the Bay Region--the first time such a plan had been attempted for a large region with environmental problems so complex. A draft of the plan was released for public review and comments in December 1977.

At the time, it was expected that the draft plan would undergo extensive revision as a result of public comments and would be approved by ABAG in April 1978. A lengthy series of public workshops and hearings were scheduled prior to actions by various ABAG-approving bodies. These include the EMTF, RPC, the Executive Board, and finally ABAG's General Assembly (in which each member city and county has a vote).

During the early stages of the public hearing process one major theme of comment emerged rapidly. It became readily apparent that local cities and counties and public interest groups did not feel adequate time had been allowed for public review of the massive plan--although almost all the recommended actions of the plan had been described in a lengthy progress report for the draft plan in September/October 1977. The fact that the air quality chapter of the plan included several controversial matters and that the schedule for review and action was compressed inevitably led to complaints that the plan was being forced down the throats of a concerned, objecting group of local governments and citizens. As a result, the original schedule was modified--to allow more time for public advice and more time for local governments to consider the plan. Figure 10-1 depicts the final process and schedule for adoption of the initial Environmental Management Plan.

Figure 10-1

Process for Developing the Plan


INITIAL TECHNICAL STAFF WORK COMPLETED
PUBLIC HEARINGS
DRAFT ENVIRONMENTAL MANAGEMENT PLAN
ENVIRONMENTAL MANAGEMENT TASK FORCE APPROVAL
ABAG REGIONAL PLANNING COMMITTEE APPROVAL
ABAG EXECUTIVE BOARD APPROVAL
ABAG GENERAL ASSEMBLY APPROVAL
STATE AND FEDERAL AGENCY APPROVALS
TECHNICAL ADVISORY COMMITTEES' INPUT
PUBLIC WORKSHOPS
DECEMBER 1977
JUNE 1978

The Joint Technical Staff, of course, fully expected that the draft plan would change through the public review and hearing process, but it was difficult to present this view without appearing defensive about the technical analysis. It was vitally important for the staff to maintain a disinterested view of their previous technical work and to fully consider the adverse reactions toward technically sound recommendations without rejecting the reactions. Crucial to the adoption process was the ability to consider public acceptability as a criterion--so was the ability to modify plan recommendations until acceptability was achieved. This did not mean, however, watering down the recommendations simply to achieve acceptability, for Federal law required a plan to attain the oxidant standard and, once attained, maintain the standard thereafter. Therefore, if certain actions were unacceptable to the public (however technically sound), they had to be replaced with other measures in order that the plan would be approved by the State and EPA.

SPECIFIC CHANGES TO THE DRAFT AQMP

Because of existing and projected air quality problems, a comprehensive strategy of additional technological controls for stationary and mobile sources, and transportation and land use controls was recommended in the December 1977 draft AQMP. All were identified as needed for meeting and maintaining the air quality standards. The draft recommendations are summarized in Table 10-1.

The review and modifications to the AQMP by the EMTF clearly illustrated how politically sensitive many of the air pollution control programs were in the Bay Region. By far the most substantial changes to the plan occurred at this first stage of policy review. Subsequent

Table 10-1. Summary of AQMP Draft Recommendations and Changes by ABAG's Policy Bodies

DRAFT PLAN RECOMMENDATIONS	CHANGES BY ENVIRONMENTAL MANAGEMENT TASK FORCE	CHANGES BY REGIONAL PLANNING COMMITTEE	CHANGES BY EXECUTIVE BOARD	CHANGES BY GENERAL ASSEMBLY
Use "best available control technology" on new and existing hydrocarbon sources, including using paints with water base and/or high solids content and closed systems for handling organic liquids.	Use "available control technology" on existing sources giving reasonable time to pay for new equipment and giving consideration to other effects of requiring such controls in each case.	No major changes.	No major changes.	No major changes.
Continue to review new and modified industrial and commercial sources (requiring low emissions or sometimes prohibiting such sources on a case-by-case basis).	Use "lowest achievable emission rate" for new or modified sources. Continue to review new and modified sources, using "offsets" and other provisions of law where possible in lieu of prohibitions. (An "offset" is a reduction in emissions from existing industry or commerce by an amount greater than the emissions from a new industry. The reduction is paid for by the new industry.)		Develop procedures other than offset to permit industrial growth and not penalize this region with respect to other regions.	
Require 50% cleaner vehicles than called for in 1977 Clean Air Act Amendments	No major changes.		No major changes.	
Carry out program of inspection and maintenance of all vehicles to insure that pollution controls are operating properly.	Make recommendation Statewide.			
Require exhaust controls on all existing, large gasoline trucks.				
	Add condition that if State or Federal requirements for vehicle controls are delayed, this region should be given extensions beyond the Federal compliance dates.			

Table 10-1. (Cont'd)

DRAFT PLAN RECOMMENDATIONS	CHANGES BY ENVIRONMENTAL MANAGEMENT TASK FORCE	CHANGES BY REGIONAL PLANNING COMMITTEE	CHANGES BY EXECUTIVE BOARD	CHANGES BY GENERAL ASSEMBLY
Increase tolls on bridges.	Add condition that increases should only be made if needed to finance public transit service improvements.	No major changes.	Delete (recommended by Metropolitan Transportation Commission [MTC])	No changes.
Impose regional parking tax.	Delete.		No major changes.	
Provide preferential parking for carpools and vanpools.	No major changes.			
Provide additional transit service.	Replace with three-fold transit improvement strategy (recommended by MTC): o MTC to adopt service improvement objectives that can be financed by existing resources o MTC to continue efforts to identify need for additional services and pursue services if justified o 35% increase in ridership if there is increased Federal and State funding.		Delete reference to 35%; call for additional transit subsidies from State and Federal governments (recommended by MTC)	
Increase bus and carpool lanes and ramp metering.	No major changes.		No major changes.	
Create an auto control zone in San Francisco central business district.	Move to continuing planning process and change to central business districts in general.		Delete from continuing planning process.	
Provide more ride sharing services such as jitneys and vanpools and develop more extensive bicycle systems.	No major changes.		No major changes.	
Alter regionwide development patterns to reduce urban sprawl and reduce automobile travel.	Move to continuing planning process.		Remove specific reference to land use policies from continuing planning process tasks.	
	Identify for Executive Board decision three categories of controls to provide needed emission reductions after 1985: o Small gasoline engines o Off-road vehicles (for example, construction vehicles) o Transportation controls such as gas tax, road tolls, and additional transit.		Carry out in 1990, or after, one or more of the following to maintain oxidant standards o Controls on small gasoline engines o Controls on off-highway vehicles o Additional transit o More stringent vehicle emission controls	

changes to be made by ABAG's RPC, Executive Board, and General Assembly were less significant in terms of the technical detail, but key to providing substantial political support for the plan as it moved through the process. The process of changes made by the EMTF and the subsequent policy review bodies represents an interesting case study of how technical analysis of a complex physical problem (in this case air pollution) is transformed into a series of publicly and politically acceptable policy recommendations for broad-based air pollution control strategies.

Attention by technical staff was given to summarizing and simplifying the presentation of the results of the analysis. The primary indicator that was used for comparative evaluation of the relative effects of the recommended strategies was the tons of pollutants removed per day. Costs were summarized in both annualized average and present discounted values, although it was recognized that there could be wide variations in the cost estimates. Some impacts of the proposals were difficult to quantify. This was particularly true regarding issues such as impacts of the plan on special populations and on the housing market.

This phase of plan development was characterized by participation from the broad spectrum of public and private organizations and concerned individuals. The models provided the quantified targets that had to be reached and the policy implications of not achieving certain tonnage reductions. As modifications were made to the initial recommendations, additional technical analyses were provided to evaluate whether the changes would result in a plan that met the Federal standards.

With respect to the draft plan recommendations, a number of specific changes were made. These changes were, for the most part, made to come up with a more widely acceptable plan. In some cases partial reruns of the models were required and in others they were not. By major category of controls the major changes (also summarized in Table 10-1) were:

o Stationary source controls - The use of "best available control technology (BACT)" for new and existing sources was changed to "lowest achievable emission rate (LAER)" for new sources (as required by the Clean Air Act of 1977) and "available control technology (ACT)" for existing sources. The main controversy regarding BACT was its precedent setting nature for plans to be prepared for other regions.

Currently the Clean Air Act defines BACT in terms of technologies identified in any approved SIP. In reality much of the controversy on BACT during the EMTF review centered around semantics. Numerous industrial representatives felt "reasonably available control technology (RACT)" should be used. The Joint Technical Staff felt that suggestion was a significant technical compromise that jeopardized the ability to prepare a plan to meet the standard. In the end, the language adopted for existing industries was "available control technology (ACT)." The definition of ACT closely resembled the definition of BACT used in the Clean Air Act. Further, in specifying a number of actual control technologies for different industries, it was generally agreed that most of the technologies were actually RACT. The significance of this last point was that no additional simulations of these types of technological controls would be needed since their representation in the models were unchanged.

The continuation of the new source review (NSR) program was also contested. It was argued that NSR meant no industrial growth--stifling the region's economy and driving out both existing industry seeking to expand and new industries seeking to locate within the region. In response to these concerns, a special study was undertaken to examine the economic, social and air quality impacts of NSR policy on the Bay Area. This necessitated additional analysis using the regional econometric model (10-1). The main conclusion of the study was that NSR would not adversely impact the region. Although considerable concern was voiced over

NSR policy, it also remained in the plan for a separate reason. The Clean Air Act requires of all areas seeking time extensions to meet the carbon monoxide and/or photochemical oxidant standards that a permit program be in place, such as NSR to review new and modified industrial sources.

- Mobile source controls - Three basic proposals for additional mobile controls were made in the draft plan: 1) requiring a 50% more stringent vehicle exhaust standard than called for in the 1977 Clean Air Act Amendments; 2) carrying out an inspection and maintenance program for light and heavy duty vehicles; and 3) requiring exhaust retrofit devices for existing heavy duty gasoline trucks. By and large, these recommendations were unchanged through the various reviews. The EMTF did recommend the latter two measures be adopted statewide. Furthermore, a condition was added in the plan that if State or Federal requirements for vehicle controls are delayed, this region should be given extensions beyond the federal compliance dates. In all likelihood the lack of controversy locally concerning proposals that have been very controversial Statewide and nationally can be explained by two major factors: 1) the responsibility for implementation rested with the California Air Resources Board and was thus once removed from the public officials developing the plan locally; and 2) no other measures available for local adoption and implementation as alternatives were acceptable for wide-scale support within the region.

- Transportation controls - A wide variety of transportation incentives and disincentives were recommended but several of the disincentives proposed to discourage private auto use were deleted during the plan review phase. These included: 1) increasing tolls on bridges; 2) imposing a regional parking tax; and 3) creating an auto control zone in San Francisco central business district. The deletions were not unexpected since the measures were locally quite controversial. The incentive-type transportation controls (in reality, transportation system improvement measures) were adopted with little, if any, changes. These measures included: 1) providing preferential parking for vanpools and carpools; 2) providing additional transit service; 3) increasing bus and carpool lanes and ramp metering; and 4) providing more ride sharing services such as jitneys and vanpools and developing more extensive bicycle systems.

  Earlier analysis with the modeling system indicated what the reduction in vehicle miles traveled could be expected from the initial transportation recommendations and the resultant tonnage reduction of air pollutants. Subsequent modifications to the transportation measures were analyzed to insure that the new package of controls would also result in the same reduction.

- Development controls and land use management - The draft plan proposed a series of land use policies and actions to reduce the overall vehicle miles traveled in the region. The objective of reduced auto travel was to be accomplished through a slightly more compact development regionwide, a better balance between jobs and housing, and a shift of more people to carpools, vanpools, and public transit. By far, the most controversy in the plan centered around the land use management proposals and they were eventually deleted entirely from the plan. The major concerns surrounding land uses were: that it would open up the possibility of regional, State and Federal regulatory bodies usurping local land use decisions, and that it would have adverse socio-economic impacts, particularly in the housing market. Additionally, the land use controls had not been demonstrated to be as effective as other control measures. For example, the modeling analysis estimated that land use management results in only about 5 percent (approximately 24 tons/day of hydrocarbons) improvement in air quality. Compared to the other measures, they appeared to be the least cost effective.

The draft plan identified land use controls as needed for long-term maintenance of the oxidant standard, as opposed to most measures which were needed to attain the oxidant standard. Thus, with their deletion, a deficit in the emission reductions needed to show long-term maintenance appeared. As a substitute for the land use controls the ABAG Executive Board in its review added the following: Carry out in 1980, or after, one or more of the following to maintain the oxidant standard through the year 2000:

- Controls on small gasoline engines
- Controls on off-highway vehicles
- Additional transit
- More stringent vehicle emission controls

The emissions inventory proved to be useful in analyzing the impacts of these proposed controls. The inventory contained the emissions reduction potential of each of these measures which could be compared with the needed 24 tons due to removing the land use management proposals.

As readily apparent from the table, the General Assembly of ABAG concurred with the Executive Board recommended plan of June 1978. The General Assembly also approved a continuing planning process for the Environmental Management Plan (the air quality portions of that process are described in the next chapter). The plan is currently being reviewed by State and Federal agencies.

Table 10-2 shows the locally adopted AQMP policies and actions.

EVALUATION OF THE PUBLIC PARTICIPATION PROGRAM

The process conducted for approval of the Environmental Management Plan was explicitly designed to produce a politically acceptable, implementable plan. Despite a great deal of controversy, the plan was adopted by ABAG's General Assembly on a 71-5 vote. Because of the importance of the plan, many groups and individuals that previously had not dealt with ABAG on a regular basis became more active as a regional constituency. They helped shape the compromises that eventually resulted in a locally adopted plan. They also helped ensure a high degree of attendance at more than 150 sessions of the EMTF and its policy and technical advisory committees.

Another "success" of the public participation program was that the task force didn't go the way of so many toothless committees--its

Figure 10-2. Air Quality Maintenance Plan Recommendations

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985	2000	RESPONSIBLE AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
I. Stationary source controls GENERAL POLICY: REDUCE HYDROCARBON EMISSIONS FROM STATIONARY SOURCES							
Action 1 Use available control technology on existing hydrocarbon sources, allowing a reasonable amortization schedule for air pollution control equipment. Available control technology means an emission limitation based on the maximum degree of reduction of hydrocarbons emitted from or which results from any emitting facility, which the permitting authority, on a case-by-case basis, taking into account' energy, environmental and economic impacts and other costs, determines is achievable for such facility through application of available methods, systems and techniques. Technology for selected processes, which have been included in the projections of emission reductions, are as follows:	225	337	Bay Area Air Pollution Control District (BAAPCD)	A - 1980 I - 1985	\$529,000[a] *\$18,000,000[b] *Costs are considered underestimates due to choice of discount rate.	Administrative/ Regulatory - Ad valorum tax revenues - ARB subvention Funds - Federal Clean Air Act funds Operating/ Maintenance - Private Capital - Private - California Pollution Control Financing Authority - Federal Small Business Administration Loan Programs	BAAPCD Enabling Legislation

PROCESS	TECHNOLOGY
Organic storage	Secondary seals
Tar pots	Loading door assembly
Paint spray booth	Incinerator or low/no solvent coatings
Architectural coating	Low solvent coatings
Dry cleaning	Closed system with solvent recovery
Cable tar coating	Incineration
Gasoline bulk storage	Floating roof or fixed roof & vapor recovery
Auto service station storage tanks	Balanced system
Auto fill operations	Balance system

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985	2000	RESPONSIBLE AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
Action 2 Continue the review of new and modified industrial facilities (new source review), using offsets and/or other provisions of the Clean Air Act Amendments of 1977 to allow for a reasonable level of growth consistent with the requirements of the act. Use technology to produce the lowest achievable emission rate (LAER), as defined by the Clean Air Act Amendments of 1977, on new and expanded hydrocarbon sources.	Combination of ACT in Action 1 and LAER are estimated to reduce hydrocarbon emissions by 225 tons/day in 1985 and 337 tons/day in 2000. From NSR and offsets, 64 tons/day are targeted for 1985. Additional emission reductions required to maintain standards will depend on regional growth rates and success of other control programs. It is highly unlikely that more than 150 tons/day can be reduced by 2000.		BAAPCD	Currently being implemented	Increased cost to industry for emission offset purchases.		BAAPCD enabling legislation

[a] Public agency

[b] Private

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day)		RESPONSIBLE AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
	1985	2000					
II. Mobile source controls GENERAL POLICY: REDUCE HYDROCARBON EMISSIONS FROM MOTOR VEHICLES							
Action 3 Implement more stringent vehicle (light duty and heavy duty) exhaust emission controls--approx. 50% reduction below 1977 prescribed levels.	-	62	California Air Resources Board (CARB)	A - 1980 I - 1990	$3,000[a] $24,910,000[b]	- Private	Mulford-Carrell Air Resources Act
Action 4 Implement Statewide inspection/maintenance program for light and heavy duty vehicles.	23	58	CARB and/or Bureau of Automotive Repair	A - 1978 I - 1985	$1,395,000[a] $16,892,000[b]	- I/M Program revenues - State General Fund	New Legislation Required
Action 5 Require exhaust control devices on existing heavy duty gasoline vehicles Statewide.	25	-	CARB	A - 1979 I - 1985	$8,000[a] $1,534,000[b]	- Private	New Legislation Required
Action 6 Permit no further delays in implementing strict emission requirements on automobiles, provided, however, that if such delays are granted by either the California Air Resources Board or Congress, this region should be provided with extensions beyond the deadlines required by the Clean Air Act Amendments of 1977.							

[a] Public agency

[b] Private

III. Transportation controls

GENERAL POLICY: REDUCE MOTOR VEHICLE EMISSIONS THROUGH TRANSPORTATION ACTIONS TO REDUCE VEHICLE USE

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985	2000	RESPONSIBLE AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
Action 7 Preferential parking for carpools and vanpools.	0.1	Not estimated separately	Cities, counties, employers, MTC.	A - 1978 I - 1985	$886,000[a]	- Federal Aid highway programs - Local Transportation Development Act funds	- Caltrans enabling legislation - Local planning and traffic control enabling legislation
Action 8 Pursue a three-fold transit improvement strategy. (1) MTC, in cooperation with transit operators, will adopt service improvement objectives which can be financed by the existing commitment of resources to transit. Improved capacity, service, and ridership are contemplated. A measure of the improvement expected should be agreed to and committed to in the context of the RTP by October 1, 1978. (2) MTC will continue its efforts to identify the need for additional services (as it has, for example, in the elderly and handicapped program and more recently in the Minority Transportation Needs Assessment Project (MTNAP) and to pursue providing additional services as they are justified. A measure of the improvement expected will continue to be developed as these special needs are examined and as the demand for transit services expands generally. (3) During the commute hours all major transit systems in the Bay Area are at capacity. Any substantial increase in ridership will be dependent upon increased Federal or State financial assistance. The amount of rider-	1.3		MTC, transit districts (e.g., MUNI, AC, BART)	A - 1978 I - 1985	$31 million[a]	- Federal Mass Transportation Assistance Programs - Fare revenues - Local Transportation Development Act Funds - State Highway Trust Fund diversions	- Local Transit District Enabling Legislation - Bay Area Rapid Transit District Enabling Legislation - Interagency Memoranda of Understanding

[a] Public agency

[b] Private

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985	2000	RESPONSIBLE AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
ship increase is directly affected by the amount of increased State and Federal funding. Provision of additional transit capacity represents a positive transportation strategy. Thus the State and Federal governments are encouraged to provide necessary funding support for transit improvements to offset any air quality deficiencies caused by deleting less desirable transportation control measures. Without this financial support, transit capacity cannot be significantly expanded.							
Action 9 Support development of high occupancy vehicle lanes and/or ramp metering on selected freeway segments when justified on an individual project basis.	0.2	Not estimated separately.	Caltrans, transit districts, cities and counties.	A - 1979 I - [illegible]	$7,438,000[a]	- Federal Aid Highway Programs - State Highway Programs funds	- AB 69 (State Transportation Planning Enabling Legislation) - AB 363 (Bay Region Transportation Planning Legislation) - Caltrans Enabling Legislation - Local Planning and Traffic Control Enabling Legislation
Action 10 Provide more ride sharing services such as jitneys and vanpools. Objectives need to be developed and monitored to gauge the desirable rate of expansion.	1.7		Caltrans, employers, MTC	A- Previously adopted I - 1979	$300,000[a]	- Federal Transportation Funding	
Action 11 Develop more extensive and safe bicycle systems and storage facilities. Objectives need to be developed and monitored to gauge the desirable rate of expansion.	2.0		Cities, counties, MTC, Caltrans	A - 1980 I - 1985	$438,000[a]	- Federal Aid Highway Programs - Local Transportation Development Act Funds	- Federal-Aid Highway Legislation - Local Transportation Development Act Legislation
Action 12 MTC is requested to consider the following action: "Complete construction of certain portions of State freeway systems in which there are now pollution-causing gaps."			MTC	1978	0		- MTC enabling legislation

IV. Other measures

GENERAL POLICY: ENSURE MAINTENANCE OF THE OXIDANT STANDARD BEYOND 1985-87

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day)		RESPONSIBLE AGENCY (OR AGENCIES)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
	1985	2000					
Action 13 Adopt between 1985 and 1987, and implement in 1990 or thereafter, one or more of the following measures to ensure maintenance of the oxidant standard through the year 2000, subject to further evaluation of the measures during the continuing planning process: o Reduce hydrocarbon emissions from small gasoline engines o Reduce hydrocarbon emissions from off-highway mobile sources o Implement more stringent vehicle exhaust emission controls--Approximately 60-80% reduction below 1977 prescribed levels. o Provide additional transit	0	24	ARB; BAAPCD; ABAG; MTC; transit operators.	A - 1985-87 I - 1990-95	To be determined	To be determined	Clean Air Act, Mulford-Carrell Act

recommendations unneeded and unnecessary. The public visibility of the task force and its composition--backed by requirements of Federal law--helped ensure that the task force's recommendations would be considered carefully. Virtually every task force recommendation was accepted without change by the ABAG policy committees and the General Assembly. General Assembly approval gave local elected officials a greater sense of local control over environmental protection strategies. Subsequently, the State Legislature adopted changes in State law recognizing the authority of ABAG's General Assembly over the content of the plan, and formalizing the Federal-State-regional partnership contemplated by various Federal laws.

Despite the adoption of the plan, there were problems that developed in the public participation program. These problems tended to be overshadowed by the plan adoption process, but should be pointed out. Public participation objectives had not been stated in quantifiable terms, making evaluation difficult. Funds were not available for public opinion surveys, which might have helped shape final control measures. There was simply not enough time for pre- and post-testing of materials produced for their effectiveness in informing the public.

The time constraints also made it difficult to provide information on localized impacts to city councils, community groups and suburban daily and weekly newspapers. Suburban dailies and television stations especially needed more individual briefing sessions. This became most obvious during the final selection of strategies and during the last few steps in the plan approval process. The staffs were seldom able to speak to community groups more than once; many lost touch with the process over the two-year period.

Earlier it was noted that the staff had to maintain a disinterested view of their previous technical work as the plan moved from its initial draft through the review bodies until it was finally approved by the General Assembly. In general, the staff attempted to provide information about the draft plan and the technical reasons why the control measures were recommended. As with most planning programs, there sometimes is a fine line between presenting information about what is recommended and "defending" the recommendations. During the early stages of the public review process, certain special interest groups--but not all--maintained that the staff was "defending" the recommendations. It is very important to recognize the ability of interest groups to communicate their points of view effectively. The agency's responsibility is to ensure that information is fairly presented.

The difficulties cited above will need more attention during the continuing planning process, described in the next chapter.

1977 CLEAN AIR ACT REQUIREMENTS

Shortly after the initial plan for oxidant was adopted by ABAG's General Assembly in June 1978, the Bay Area agencies (ABAG, BAAQMD and MTC) received preliminary comments on the plan as it related to requirements of the 1977 Clean Air Act. Three key points of the comments were that the plan needed to include:

- o Demonstration of reasonable further progress
- o Implementation of EPA's RACT Measures

o Demonstration of legal, financial and manpower commitments to carry out the plan.

Demonstration of Reasonable Further Progress

On receipt of the comments, the agencies in the Bay Area projected reductions in stationary source organic emissions for the industrial source categories in the BAAQMD baseline inventory. Also projected was the course of motor vehicle emission reductions. The adopted transportation controls were assumed to be of negligible effectiveness prior to 1982, consistent with the implementation schedule in the plan, then assumed to be of linearly increasing effectiveness between 1982 and 1985. The cumulative course of the control recommendations were then described. It was shown that the plan's control measures will provide more than minimum reasonable further progress toward attainment of the 0.08 ppm oxidant standard.

Implementation of EPA RACT Measures

The Clean Air Act Amendments of 1977 require the use of reasonably available control technology--at a minimum--in all areas of the country where the 0.08 ppm oxidant standard is being exceeded. In October 1978, EPA identified reasonably available control technologies (RACTs), also known as control technology guidelines (CTGs) for 12 categories of sources. Controls for additional source categories are forthcoming.

On comparing the EPA-defined RACTs with existing local regulations, the Bay Area Air Quality Management District found that two existing district regulatory requirements are more stringent. Eight BAAQMD regulatory requirements are less stringent than RACT requirements. One source does not exist in the district, and one District regulation is equivalent but needs clarification. A comparison of the RACT requirements with 1978 District regulations is shown in Table 10-3. Table 10-4 is a summary comparison of emission reductions from EPA RACT measures with those attributed to Action 1 - Available Control Technology by source category.

To comply with the 1977 Clean Air Act requirements, the District set public hearings through March 1979 to consider adoption of proposed rules. For other source categories not covered by current EPA CTGs, but for which emission reductions have been identified in Action 1, the District plans to adopt and implement regulations on the tentative schedule shown in Table 10-4.

Demonstration of Legal, Financial and Manpower Commitments

This task was identified for completion early in 1979 as the non-attainment plan (covering photochemical oxidants, carbon monoxide and total suspended particulates)--adopted by ABAG's General Assembly in January 1979--moved through the approval process at the State and Federal levels.

Table 10-3. COMPARISON OF EPA RACT MEASURES AND BAAQMD REGULATIONS

	EPA RACT MEASURE	CONTROL REQUIRED	BAAQMD REGULATORY CONTROL	COMMENT
1.	Service Station Phase I (Tank)	90%	90% (Reg 2)	No new regulation needed.
2.	Fixed Roof Tanks	Internal Floating Roof	Secondary Seals (Reg 3)	District more restrictive. No new regulation needed.
* 3.	Gasoline Bulk Plants (Truck filling)	95% Vapor Balance	60% (Reg 3) Proposed Reg 13	District less restrictive. New regulations needed.
* 4.	Gasoline Bulk Terminals	95%	95% Proposed Reg 13	Need to modify Reg. to include smaller terminals and consider spills and leaks.
* 5.	Metal Degreasing	85% Control Overall	85% if > 40 lb/day 0% if <40 lb/day (Reg 3)	District less restrictive. New regulation needed.
6.	Cut Back Asphalt	No Organics Allowed	Allows 400 lb/ton (Reg 3)	District less restrictive. New regulation needed.
* 7.	Auto Body Painting	70%	20% (Reg 3) Proposed Reg 17	District less restrictive. New regulation needed.
* 8.	Can Coating Fabric Coating Paper Coating Coil Coating	50-80%	20-40% (Reg 3) Proposed Reg 14 and 16	District less restrictive. New regulation needed.
* 9.	Metal Coating	80%	20-50% (Reg 3) Proposed Reg 14	District less restrictive. New regulation needed.
*10.	Large Appliance Manufacture	80%	20-50% (Reg 3)	District less restrictive. New regulation needed.
11.	Magnet Wire Insulation	80%	Less than 80% (Reg 3)	District less restrictive (No operations in District)
12.	Refinery: a) Vacuum systems b) Waste water systems c) Process unit turn arounds	Best Modern Practices	Best Modern Practices Proposed Reg 18	District about the same. Regulations need clarification.

* Denotes ARB Model Rules adopted or in preparation.

Table 10.4 COMPARISON OF EPA RACT MEASURES WITH AVAILABLE CONTROL TECHNOLOGY BY SOURCE CATEGORY IN 1985

EPA RACT MEASURES	BAAQMD SOURCE CATEGORIES (#)	REDUCTION ESTIMATES TONS/DAY (T/D)		ESTIMATED REGULATION DEVELOPMENT SCHEDULE	
		EPA	BAY AREA PLAN	ADOPTED	IMPLEMENTED
1. Service Stations Phase I	#26, 27, 28 Vehicle Fill & Tanks	27.0*	0*	1972	1975
2. Fixed Roof Tanks	#23 Storage & Blending	14.9	14.9	1977	1978
3. Gasoline Bulk Plants	#25 Bulk Plants	6.8	6.8	1979	1980
4. Gasoline Bulk Terminals					
5. Metal Degreasing	#35 Degreasers	35.0	35.0	1979	1981
6. Cut Back Asphalt	Not in BAAQMD Inventory	20.5**	0**	1980	1983
7. Auto Body Painting				1979	1983-5
8. Can & Coil Coating Fabric & Paper Coating	#31 & #32 Industrial Coating--Solvent and Water Base	38.3	38.3	1979	1981-2
9. Metal Coating					
10. Large Appliance Mfg.					
11. Magnet Wire Insul.					
12. Refinery a) Vacuum System b) Wastewater c) Process Unit Turnaround	***#2 is Valve Leaks @ 7.4 T/D; Vac. Sym.@ 2.5 T/D; A.P.I. @ 3 T/D Load Racks @ 3 T/D; Misc. 1 T/D; #3 U/B & Flares @ 2.6 T/D	19.5	19.5	1979	1982
Subtotal	--	162.0	114.5	--	--
ACTION 1 SOURCE CATEGORIES NOT COVERED BY CURRENT EPA RACT					
A. Other Chemical	#9	0	2.6	1982	1983
B. Other Ind/Com	#10 Pulp/Paper; #19 Food/Agri.	0	4.1	1982	1983
C. Marine Loading	#24	0	4.6	1980	1982
D. Solvent & Other Tanks	#29 & #30	0	7.7	1981	1982
E. Coml/Dom Coatings	#33 & #34	0	21.7	1980	1982-3
F. Dry Cleaners	#36 & #37	0	13.0	1980	1982
G. Rubber Fabrication	#38	0	4.7	1981	1983
H. Plastic Fabrication	#39	0	23.0	1982	1984
I. Printing	#40	0	9.0	1980	1982
J. Other Organic Evap.	#41	0	20.0	1981	1983
Subtotal Source Categories Not Covered By Current EPA RACT		0	110.4	--	--
TOTAL EPA RACT AND ACTION 1 ACT		162 - 27= 135	224.9		

* Service Station Phase I Control was completed in the Bay Area prior to EPA guidance. It was not included in Action 1 emission reduction estimates.

** Cut back asphalt was not included in emission inventory and no credit was taken in Action 1. The emission reduction will occur when a new district regulation is implemented.

*** A.P.I. separators; U/B - upset/breakdown

REFERENCE

10.1 Leong, E. Y., et al, "A Methodology for Analyzing Alternative Oxidant Control Strategies," presented at the 71st Annual Meeting of the Air Pollution Control Association, Houston, June, 1978.

Chapter 11

THE CONTINUING PLANNING PROCESS

The draft 1979 air quality plan for the San Francisco Bay Area contains provisions for continuing planning to ensure that the control programs included in the plan are being implemented. The continuing planning process is also necessary to ensure that the Bay Area continues to comply with the legal requirement for making "reasonable further progress" toward attainment of air quality standards. The continuing planning process established in the Bay Area will provide the appropriate forum for accomplishing a number of tasks. They may be categorized as follows:

- Data collection needed to support additional control programs.
- Air quality analysis to support additional control programs.
- Control strategy development and assessment of controls for oxides of nitrogen and its effect on oxidant formation.
- Monitoring implementation of the initial plan to ensure that reasonable further progress is being made toward attainment of the oxidant standard.
- Development of a regionwide oxidant plan for review and adoption in the 1981-1982 time period.

ORGANIZATION FOR CONTINUING PLANNING PROCESS

The institutional organization for the continuing planning process will rely heavily upon the mechanisms and procedures developed for the preparation of the initial plan. The ABAG will continue to be the lead agency for the Bay Area Air Quality continuing planning. The BAAQMD and the MTC will continue to play key roles in all future planning and implementation activities related to the Bay Area Air Quality Plan. Responsibilities for conducting future planning tasks are assigned in a joint memorandum of understanding between ABAG, the BAAQMD and the MTC. The process for both technical and policy evaluation of future planning work will be similar to the process successfully used in the initial plan preparation (see discussions in Chapter 2). Key working groups and their responsibilities for continuing air quality planning in the Bay Area are summarized below:

- Joint Technical Staff - composed of staff members from ABAG, MTC, BAAQMD, ARB, EPA, and the California Department of Transportation (Caltrans). This group is responsible for the development of alternative control strategies and the technical assessment of their effectiveness and impacts.
- Modeling Sub-Committee - composed of staff members with specialized air quality modeling expertise from ABAG, MTC, BAAQMD, Caltrans, ARB, EPA, and Lawrence Livermore Laboratory (LLL), Systems Applications, Inc. (SAI), and SRI International (formerly Stanford Research Institute). This group is responsible for specification of the air quality modeling methods to be used, and review of the results obtained.
- Air Quality Advisory Committee - composed of interested individuals from private industry, local government staff, and special interest groups. This committee is the vehicle by which progress on plan preparation is communicated to interested individuals and organizations that are not participating directly in the effort. It provides a formal and continuous opportunity for such individuals to communicate concerns and comments on the work being done both to the staff and to the various policy bodies who will be reviewing the plan.
- Interagency Management Group - composed of executive staff of ABAG, MTC, and BAAQMD. This group functions to provide key administrative and policy guidance to the Joint Technical Staff and serves as a bridge between technical staff and the policy review bodies.
- ABAG Regional Planning Committee (RPC)- This committee is composed of elected representatives of cities and counties in the Bay Area, and representatives of special and public interest groups. It functions as the principal policy review

body in ABAG for plan development, inheriting the role of ABAG's Environmental Management Task Force.

- o ABAG Executive Board - This group is composed of elected representatives of cities and counties in the Bay Area, and functions as the month-to-month governing board for ABAG. All plans and matters of regional policy produced by ABAG must receive review and approval by the board.

- o Metropolitan Transportation Commission - This group is composed primarily of elected representatives of cities and counties in the Bay Area, and functions as the governing board for MTC. All plans, funding priorities and policies related to transit and major transportation projects must receive review and approval by this commission

- o BAAQMD Board of Directors - This group is composed of elected representatives of counties in the Bay Area, and functions as the governing board for the BAAQMD. The activities and regulations of the District must receive approval from this board.

- o ABAG General Assembly - This body includes elected representatives from each ABAG member city and county of the Bay Area. Each year, the General Assembly approves the annual update of the Environmental Management Plan.

- o California Air Resources Board - This body is composed of individuals appointed by the Governor and has the authority to set motor vehicle emission standards. It also is responsible for preparation and submittal of the State Implementation Plan for California to EPA. In addition, it can override the authority of local air pollution control districts such as the Bay Area Air Quality Management District in regulating emissions from stationary sources.

FUTURE WORK AND RESEARCH NEEDS

The revised staff-recommended oxidant control plan was approved by ABAG's General Assembly on January 13, 1979. This locally adopted oxidant plan is currently being reviewed by the CARB with respect to its adequacy for adoption as part of State SIP to be submitted to U.S. EPA.

At present, ABAG is preparing an application for Federal funds authorized under Section 175 of the Act to support the future air quality planning work. A number of tasks will be pursued to insure that the elements of the 1977 oxidant plan are being implemented. ABAG will be monitoring and evaluating implementation of adopted control programs. In addition to tasks that follow up on the adopted plan, other technical tasks are planned in order to address the issues related to oxidant long-range transport. In particular, the feasibility of extending the LIRAQ modeling analysis to cover larger areas will be investigated along with other alternatives. If an appropriate analysis technique can be developed, the impacts of different levels of NO_x emissions in the Bay Area on oxidant levels in other air basins will be tested. Once the role of Bay Area NO_x emissions on neighboring regions is identified, appropriate control measures can be developed if necessary.

More tests will be conducted to determine the sensitivity of peak oxidant levels to spatially variable controls. For example, the effects of strategies to control only those emissions that are directly responsible for the peak oxidant concentrations will be analysed. Future work is also needed to identify industrial growth increments in precursor emissions and to implement an industrial siting process. The need for certain transportation controls, e.g., retrofit devices on heavy-duty gasoline-powered vehicles, will be reassessed. In response to the recent change in Federal 1-hr oxidant standard from 0.08 ppm to 0.12 ppm, ABAG is in the process of reevaluating its previously adopted oxidant control plan to see what changes are appropriate. The continuing planning process will insure that the oxidant standard will be attained by the mandated deadline and will continue to be maintained in future years.